VARIABLES RELATED TO STUDENT PERFORMANCE ON THE COMPREHENSIVE QUALIFYING EXAMINATION FOR MIDSHIPMEN ABOUT TO BE COMMISSIONED AS NAVAL OFFICERS

By

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The purpose of this study was to explore the relationships among several independent variables indicative of university and Naval Reserve Officers Training Corps (NROTC) entrance criteria and performance measures and the results obtained on the Navy Comprehensive Examination (NCE), across several categories of students, with the intent of determining which, if any, of the independent variables relate significantly to NCE scores. The NCE has been considered as a valid competency examination and pre-professional entrance examination, indicating readiness for entry into post-accession training and the naval profession.

The study population was comprised of 133 NROTC students of the University of Florida who completed the NCE in academic years 1980-1983.

Problems addressed in the study were the Navy-wide requirement for an 80%/20% ratio of technical majors to non-technical majors and the appropriateness of the use of the

Scholastic Aptitude Test (SAT), particularly the mathematics section of the SAT, as a criterion for the award of Navy scholarships, and the usefulness of university grade point average (UGPA) and Naval Science Department grade point average (NGPA) as indicators of performance while in the NROTC.

Summary data and matrices of correlation coefficients for all variables were determined for the entire study population and for sub-populations sorted on various categories of students. Linear regression analyses were used to determine predictive equations for NCE scores.

Students completing technical majors were found to attain higher scores on the NCE than their non-technical counterparts. All independent variables were found to relate to NCE scores. The best predictive equation contained variables NGPA and SAT score (total). The emphasis on the mathematics section of the SAT as an entry criterion was not found to be justified, the data indicating that the verbal portion of the test was more closely related to NCE scores.

A finding not directly related to the purpose of the study was that the mathematics section of the SAT was not significantly related to UGPA for the study population or for any of the sub-populations, with the exception of the sub-population of students not receiving Navy scholarships.

CHAPTER I

INTRODUCTION

Beginning with academic year 1980-1981, the United States Navy has required all senior midshipmen in Naval Reserve Officers Training Corps (NROTC) units to take a comprehensive examination during the year in which they are to graduate. The examination covers the content of six Naval Science courses presented by the Naval Science Department at each institution having an NROTC unit. These courses are required of all NROTC midshipmen seeking a commission in the United States Navy. Content of these courses and the objectives to be attained by students taking the courses are designed to guide students in the achievement of the minimum professional core competencies contained in part one and part two of the Minimum Professional Core Competencies (MPCC) Manual for Officer Accession Programs (Chief of Naval Operations, 1982).

The usefulness of this comprehensive examination lies primarily in two areas: one addressing individual student performance and the other addressing performance of individual naval science departments and the comparisons of departments. Only the first of these areas is addressed in the study which follows. In this instance the examination

serves as a qualifying examination, indicating whether or not the individual examinee can demonstrate sufficient knowledge necessary to meet minimum competency requirements for commissioning as an officer in the United States Navy and for entry into post-acquisition training.

Navy Reserve Officer Training Corps (NROTC), offered through host institutions of higher learning, is one of two primary sources for the commissioning of regular officers into the United States Navy, the other being the United States Naval Academy. Midshipmen enrolled in the NROTC program are required to complete all institutional requirements for a baccalaureate degree in a scientific or technical major or in an academic area of interest to the Navy. Since 1976 it has been the policy of the Chief of Naval Operations (CNO) that 80% of all NROTC scholarship midshipmen be enrolled in a technical major (Chief of Naval Operations memorandum dated August 3, 1976; Subject, NROTC policy statement) as defined by Chief of Naval Education and Training (CNET) Instruction 1533.12. Additionally, midshipmen are required to complete a sequence of courses offered by the Naval Science Department of the host institution.

Entry into the NROTC as a scholarship student requires competitive selection on a series of criteria, with Scholastic Aptitude Test (SAT) scores being particularly heavily weighted. Particular attention is placed on the mathematical portion of the test. Entry into the NROTC as a non-scholarship student is also affected by SAT scores,

since SAT is most frequently used as an entry criterion for entry into the host institution. Grade point average at the host institution, grades in naval science courses, and aptitude assessments are the principal measures used to evaluate student performance while in the NROTC program.

Statement of the Problem

If the Navy Comprehensive Examination is a valid indicator of competence to enter the profession of Naval Officer and for entry into post-accession training, several problems concerning the NROTC program may be addressed. Among these problems are those concerning selection, in-school performance evaluation, differential performance of various sub-groups of the student population, and the necessity for the requirement of the ratio of technical majors. The problems addressed in this study are stated explicitly in the questions which follow. Are the selection and in-school performance measures currently in use appropriate? Are there differences in performance attributable to differences in sexual, racial, and other sub-populations students? Is the requirement for the ratio of technical to non-technical majors valid? What variables best predict student performance on the Navy Comprehensive Examination?

Purpose of the Study

The purpose of this study was to explore the relationships, if any, among several variables indicative of university and NROTC entrance criteria, examinee performance, both academically and naval science related, and the examinees' scores on the Navy Comprehensive Examination (NCE) for various differentiations of the student population. Where relationships among variables were found to be of statistical significance, the significant variables were to be incorporated into predictive equations and the degree of predictability obtainable was assessed.

Hypotheses

This study tested the following hypotheses. The hypotheses are stated in the null form.

1. There are no relationships between the categorical variables of sex, race, major, and program and scores on the Navy Comprehensive Examination.

2. There are no relationships between the entry variables of Scholastic Aptitude Test scores and scores on the Navy Comprehensive Examination.

3. There are no relationships between the performance variables consisting of undergraduate grade point average, Naval Science Department grade point average, and aptitude

quartile scores and scores on the Navy Comprehensive Examination.

4. There are no relationships among the categorical, entry, and performance variables.

5. The categorical, entry, and performance variables provide no predictive indication of Navy Comprehensive Examination scores.

Background and Justification

In recent years considerable attention has been focused on the NROTC program by the Secretary of the Navy (SECNAV), Chief of Naval Operations (CNO), the Chief of Naval Education and Training (CNET), and the Association of NROTC Colleges and Universities (Heidt, Zajkowski, & Hodak, 1979; Heidt & Zajkowski, 1982). Among areas of particular attention have been (a) the means for measuring the adequacy of each midshipman's preparation for performance in post-acquisition training, including the identification of performance differences of various sub-groups of the population; (b) effect of technical education on performance in post-acquisition training programs and the validity of current requirements for technical/non-technical ratios in majors; (c) the identification of valid means by which NROTC units may be evaluated and compared, including criteria for disestablishment of non-productive units and guidelines for the selection of host institutions for new units; and

(d) selection criteria for entry into the NROTC scholarship program.

The concern surrounding the technical majors requirements, particularly the inability of several host institutions without strong engineering and science colleges and those with major emphasis on Arts and Letters, to meet the requirements and the accompanying expectation of disestablishment of NROTC units at those institutions, led to a proposal by the Association of NROTC Colleges and Universities for a program revision eliminating the need for the technical majors requirements. This program revision was in the form of a NROTC curriculum change. A pilot program was developed to evaluate the effects of the proposed change on student selection, retention, and evaluation and the effects on post-accession training results. Incorporated into the study of the pilot program was a broad study of the NROTC program results in general. Appendix A lists the institutions involved in the pilot study. Results of the pilot study are not expected before 1990 (Training Analysis and Evaluation Group, 1980).

The introduction in 1980 of the Navy Comprehensive Examination allows some preliminary conclusions to be drawn relative to the above stated concerns, prior to the completion of the broader study. In particular, problems related to selection criteria, in school performance measurement, and the differential effects of types of majors can be addressed. From analyses of data from an institution

which has an NROTC student population which is typical of the national NROTC population, policy makers are provided with information of value in making program decisions prior to the completion of broader studies and of value in indicating direction for additional studies.

Though it is recognized that the data used in this study do not represent a statistically determined sample of the national population, several factors indicate the choice of data from the University of Florida to have been appropriate for this study. Telephone conversations with the Head, NROTC Section, Naval Education and Training Command (November 19, 1981), and with the Head, Officer Training Programs, Naval Education and Training Command (November 20, 1981) established that the University of Florida NROTC population was typical of the national population as to selection criteria and academic major selection distribution. The study by Heidt and Zajkowski (1982) showed the post-accession training performance of University of Florida NROTC graduates to be similar to that of all NROTC graduates. That study is discussed in Chapter II and summary data are presented in Appendix B. The means of scores on the Navy Comprehensive Examination obtained by University of Florida students were not significantly different from the means of the national population taking the examination, and the distribution of scores was reported to be similar to the total population. The results of the

Navy Comprehensive Examination are reported in subsequent chapters of this study.

Scope and Limitations

The subjects used in this study were limited to navy option midshipmen from the University of Florida NROTC unit who took the Navy Comprehensive Examination (NCE) in the four academic years 1980-1981 through 1983-1984. The entire population comprised the study population; therefore, no sampling error existed (Agresti & Agresti, 1979; Keppel, 1982). Not all data sets contained information on all data elements. Each calculation was accomplished on the applicable data sets for which complete information was available (Helwig, 1978).

Data accuracy was limited to the extent that source data were accurate. Data that were duplicated in more than one data base were cross checked and if discrepant data were discovered, additional sources were consulted. Primary sources of data included various U.S. Navy records.

Only data concerning those midshipmen who remained in the University of Florida NROTC unit through the point in time of taking the NCE were used. Any inference relative to the independent or categorical variables of the study used to describe the entire NROTC unit population are invalid to the extent that the study population did not include any students who did not complete the NROTC program prior to the

taking of the NCE (Agresti & Agresti, 1979; Keppel, 1982; Mehrens & Lehman, 1978).

Aptitude data were obtained using a composite ranking of aptitude standing for the three years prior to taking the NCE. Since students who left the NROTC program were included in prior years' aptitude rankings, the quartile aptitude scores were not evenly distributed.

The findings of the study are generalizable to future populations of midshipmen at the University of Florida and to populations of other institutions, both present and future, only to the extent that the study population is statistically similar to those populations (Agresti & Agresti, 1979; Mehrens & Lehman, 1978).

The Navy Comprehensive Examination was assumed to be a valid indicator for purposes of competency assessment. Proof of the validity is left to subsequent studies.

Definition of Terms

Aptitude (AP). Aptitude, for the purpose of this study, is an evaluation of aptitude for commissioned service in the United States Navy. This score is a weighted composite of evaluations by instructors in the Naval Science Department, peers, and midshipmen of senior rank in the NROTC unit chain of command. This evaluation consists of a numerical grade (range 0.0 to 4.0) and an ordered ranking.

Grade point average (GPA). The grade point average is the numerical average of letter grades awarded at the

completion of courses taken over the period specified. Letter grades equate to the following numerical values: A = 4.0, B = 3.0, C = 2.0, D = 1.0, E = 0.0. In this study two data elements concerning grade point averages were used. University grade point average (UGPA) consists of the cumulative grade point average for all courses attempted at the University of Florida. Naval Science grade point average (NGPA) consists of the cumulative grade point average of all courses attempted in the Naval Science Department at the University of Florida.

Graduation status. Graduation status indicates whether the subject either graduated and was commissioned, graduated but was not commissioned, or did not graduate and could not be commissioned.

Major. Major is the academic field of study in which the subject received a degree or was attempting a degree upon departure from school.

Navy Reserve Officer Training Corps (NROTC). NROTC is an officer procurement program offered at approximately 60 institutions of higher learning in the United States.

Navy Comprehensive Examination (NCE) score. A normalized score for each section of the examination and for the entire examination is reported for each examinee. These scores are normalized nationally for each offering of the examination on a mean of 50 and a standard deviation of 10. Three scores were recorded for each subject: the score received for the section pertaining to shipboard

engineering, the score received for the section pertaining to weapons systems engineering, and the score earned over the entire examination.

Program. Program has two elements. The first concerns whether or not the subject received a Navy scholarship, i.e., tuition and books paid for by the Navy, and by what competitive means the subject was awarded the scholarship. The second element pertains to the number of years the subject was a member of the NROTC unit.

Race. Race is the classification of subjects by genetic heritage to one of the following groups: Caucasian, Negro, American Indian, or Asian.

Scholastic Aptitude Test (SAT). The scores on the scholastic aptitude test are part of the admissions data recorded for the subject. Three scores are reported: (a) the score obtained on the mathematics portion of the test (MTH), (b) the score obtained on the verbal portion of the test (VRB), and (c) the composite score (STOT).

Technical/non-technical major. Technical or non-technical major differentiation is made in accordance with guidelines established by the Chief of Naval Education and Training (CNET) as contained in CNET Instruction 1533.12B.

CHAPTER II

REVIEW OF THE LITERATURE

In this chapter literature related to the purpose of the reported research is reviewed. The chapter is comprised of five major sections:

1. Studies relating educational success and subsequent success.

2. Studies relating to the predictability of professional and graduate school performance.

3. The relationship between NROTC program parameters and post-graduation training.

4. Studies related to sex and race as factors in performance prediction.

5. A study pertaining to faculty evaluation of leadership potential.

These sections present literature relevant to the selection of variables evaluated in the testing of the hypotheses of the study.

A review of the literature revealed an abundance of studies related to performance prediction for college students, both as related to school performance and as related to subsequent activities. However, the literature did not include any studies pertaining directly to the Navy Comprehensive Examination. In the chapter that follows

works of researchers and writers which gave insight into factors likely to have an impact on the choice of variables for the study, or which contributed to interpretations and conclusions of the study, are reviewed.

Studies Relating Educational Success and Subsequent Success

Education, particularly higher education, has long been touted as the key to success and competence (Bowen, 1978). Often it is assumed that performance at an educational institution, as measured by grades received, is an indicator of eventual professional success (Samson, Grace, Weinstein, & Walberg, 1984).

Calhoun and Reddy (1968) contended that grade point average and position in the graduating class constitute the two most used criteria for predicting business success used by business and college placement officials. The rationale, they surmised, is that grades indicate ability and ability indicates success (Calhoun & Reddy, 1968).

There exists an abundance of studies attempting to relate undergraduate performance to subsequent success. In order to assimilate as much information as possible from these sources, four extensive syntheses of research were reviewed. Two (Calhoun & Reddy, 1968; Hoyt, 1965) are of a conventional nature, reviewing each included study individually as to statistics, findings, and faults. The other two studies (O'Leary, 1980; Samson, Grace, Weinstein,

& Walberg, 1984) used meta-analysis techniques to make inter-study comparisons.

In a synthesis of research reported in the 50 years prior to 1968, Calhoun and Reddy (1968) analyzed 15 studies relating academic performance in higher education and success in business or professions. In all studies academic success was measured either by final grade averages or class standing. Success in business or profession was measured by income relative to others in the profession.

Of the 15 studies reviewed by Calhoun and Reddy (1968), seven yielded no correlation between success and academic achievement, four indicated weak correlation, and four studies indicated a positive correlation. All the reviewed studies were faulted for low response rate and inferences that possible subjects with low grades and/or success declined to participate (Calhoun & Reddy, 1968). Other factors pertaining to college participation reviewed for correlation with success as described above were extracurricular activity, considered in eight studies, five of which showed correlation; varsity athletic participation, included in four studies, all with correlation; and choice of major, considered in eight studies with no correlation found.

Hoyt (1965) reviewed 46 studies relating undergraduate grade point average and success in the following eight categories: (a) business, (b) teaching, (c) engineering, (d) medicine, (e) scientific research, (f) miscellaneous

occupations, (g) recognized successful individuals, and (h) non-vocational accomplishments. Hoyt (1965) stated that "research in the area is plagued by many theoretical, experimental, measurement, and statistical difficulties. Present evidence strongly suggests that college grades bear little or no relationship to any measure of adult accomplishment" (p. 1).

Confounding variables in the studies reported by Hoyt (1965), as well as in most other such studies, were (a) the multifaceted measure of vocational success, (b) the differing levels of grading practices and academic abilities at the institutions compared, (c) the timing of success assessment, and (d) the many intervening factors between the time of leaving academia and the measure of success.

In the studies analyzed by Hoyt (1965) relating to the business, teaching, and engineering professions, a very small number (5 of 24) of studies indicated a correlation between college grade point average and success measures. One of the studies (Cole, 1961) indicated that teaching success was more closely related to personality characteristics than to any other measure. Reviewed studies related to the medical and to miscellaneous occupations showed no correlation between higher education grades and success measures. Of the reviewed studies considering non-vocational measures of success, the only significant correlation reported was that of undergraduate GPA with amount of higher education, a not altogether unexpected

finding, since undergraduate GPA is most often a selection criterion for graduate education (Hoyt, 1965).

Hoyt (1965), concluding that undergraduate grades fail to provide suitable predictors for success as success was measured in the reviewed studies, defined the usefulness of grades as measures of retained knowledge.

> Since there is no necessary relationship between what a person knows and what he does with his knowledge, the validity of grades should be established by determining how well they measure the amount of knowledge the student possesses, not by how "successful" the student is in his subsequent enterprises. (Hoyt, 1965, p. 46)

Hoyt (1965) concluded from his review that grades are measures of general intelligence, superficial knowledge, test wiseness, sensitivity to bias of the instruction, and transient knowledge.

In a more recent study utilizing meta-analysis as described by Glass, McGan, and Smith (1981), Samson, Grace, Weinstein, and Walberg (1984) analyzed 35 studies of association, all conducted since 1950, between academic and occupational performance. By assigning weights to various conditions in the 35 studies the authors quantified data for 209 possible correlations. The weighted mean for the 209 possible correlations was found to be 0.155. This mean correlation of academic and professional success was very similar to a weighted mean correlation of 0.177 obtained by O'Leary (1980) in an analysis of 27 studies reported in Psychological Abstracts between 1964 and 1974. Samson et al. (1984) found that significant indicators of academic

success such as grades and test scores account for 2.4% of the variance in measures of occupational success such as income, job satisfaction, and performance ratings.

The conclusions drawn by Samson et al. (1984) that "most research over the past 80 years has suggested that the relationship between college grades and success in a profession is minimal" (p. 312) is similar to that reached by Nelson (1975) on the same subject. "Although technical inadequacies of much research in this area make conclusions difficult to draw, the empirical evidence implies that grade point average is a poor predictor of later vocational success" (Nelson, 1975, p. 1).

Lewis and Nelson (1982) in a study of 575 graduates of Winona State University, Minnesota, explored correlations between undergraduate GPA and the following: attainment of graduate or professional degrees, income, extent of community involvement, and, for female subjects only, political activity. The subjects were sorted by sex and group correlations (by sex) were explored as well as correlations involving the entire subject set. The only finding of statistical significance was that of a negative relationship between undergraduate GPA and extent of community involvement for male subjects (Lewis & Nelson, 1982).

An extensive analysis of the relationship among student ability, performance in training schools, and subsequent on the job evaluations of the graduates by supervisors resulted

from the U.S. Navy Training Analysis and Evaluation Group (TAEG) study of "A" schools (first level occupational training schools). The study had as its main purpose the comparison of schools taught by individually paced methods and those taught by class paced methods (Freda, Hall, & Ford, 1982). Freda et al. compared schools on three criteria: (a) internal training effectiveness as measured by end of course grades, (b) external training effectiveness as determined by fleet supervisors ratings reported using the Navy Training Appraisal System, and (c) training efficiency as determined by time to complete training.

Student ability for the subject students was determined by two parameters: general ability, defined by scores on the Armed Forces Qualifying Test (AFQT), and specific skills levels, defined by forming selected composite scores applicable to the content of the "A" schools attended from the Armed Services Vocational Aptitude Battery (ASVAB) subtest scores. This study of 22 schools, 13 of which were conducted by individually paced methods, and nine of which used group paced methods, included 5,811 graduates. A correlational type approach was used for analysis (Freda, Hall, & Ford, 1982).

Findings of particular interest included the following observations:

1. General ability and specific skill levels were highly correlated.

2. Higher ability, both general and specific, was consistently related to higher course grades in individually paced courses. In conventionally paced courses which employed differential grading, ability level correlated with grades in three of seven courses.

3. In individually paced courses, shorter training time was related to higher ability. In group paced courses, though training time variation existed due to remediation, no correlation of time with ability was found.

4. There was no difference in the predictive quality of general ability and specific ability in forecasting grades for either method of teaching.

5. Neither general ability nor specific ability predicted fleet supervisors' rating of performance.

6. Fleet supervisors rating did not correlate with course grades, time to complete training, or ability levels (Freda, Hall, & Ford, 1982).

It should be noted that the correlations reported contained no data from students not completing the course of study and predictive usefulness of the ability measures as concerns completion of the courses was not studied.

Research, in several respects similar to that reported by Freda et al. (1982), was conducted by the U.S. Air Force Human Resources Laboratory (Valentine, 1977). Forty-three training groups formed the statistical base for the exploration of the specific contributions of educational data and ASVAB scores to training success and for the

assessment of the homogeneity of prediction equations when sorted by sex and race.

In the study by Valentine (1977) comparisons were made on a set of 15 regression equations for each training group, using all subjects and sortings by race, sex, test score levels, and education levels. Education data for forming the levels consisted of grades, class standing, and highest level attained prior to entry into the Air Force. These data were confounded by the problems related to equating performance across a so widely varied field (Valentine, 1977). The ASVAB scores used were those from sub-tests applicable to the content of the training course to be completed.

Valentine (1977) concluded that test scores (ASVAB) and education level were better predictors when used in combination, and that test score was the better of the two if only one was to be used. In general, subgroup predictions equations by sex and by race were found to be superior to homogeneous prediction equations. It was also found that predictions using education data alone were more susceptible to racial bias than predictions using test scores alone (Valentine, 1977).

Studies Relating to the Predictability of Graduate and Professional School Performance

Comprehensive examinations and qualifying examinations often form part or all of the entry and graduation criteria

for graduate schools and professional schools. Medical boards, bar examinations, engineer-in-training examinations, engineer licensing examinations, Admission Test for Graduate Study in Business (GMAT), Law School Admission Test (LSAT), and doctoral qualifying examinations are among such examinations. The Navy Comprehensive Examination is, to an extent, similar to the above for NROTC students, since satisfactory performance on the examination is a prerequisite for entry into the profession of Naval Officer (commissioning) and for assignment to advanced professional education (post-accession training). A review of literature related to such examinations comprises the following section.

Zeleznik, Hojat, and Veloski (1983) conducted a study of 1284 students of the Jefferson Medical College in Philadelphia during the period from 1965 to 1974. Zeleznik et al. compared medical board examination scores, Scholastic Aptitude Test (SAT) scores, and medical school grades using analysis of variance (ANOVA) procedures. Subjects were sorted into quartile groups on both the verbal section (SAT-V) and the mathematical (SAT-M) section of the SAT medical school grades, by year, and medical board examination scores, by part, were recorded for each subject.

Both SAT-M and SAT-V were found to correlate with GPA's for the first and second years of medical school and with medical school entry and medical board examinations. The SAT scores did not correlate with final year medical school

grades and only SAT-V had correlation with third year grades (Zeleznik et al., 1983).

A review of the form of testing used in first and second year of medical school, the medical school entrance examination, and medical board examinations showed them to all be of the same form as that of the SAT, that of multiple choice answers to objective questions. The GPA's for the third and fourth years of medical school were awarded on clinical performance (Zeleznik et al., 1983). The above findings lead to a strong implication that test form similarity might have accounted for a considerable portion of the correlation among first and second year GPA and medical school entry and medical board examinations.

Markert (1982) found significant correlation among undergraduate GPA, medical college entrance examination score, and first year medical college GPA in a study of first year medical school grades, various personality measures, medical school aptitude, and pre-medical school academic measures. Of the predictors, undergraduate GPA was the strongest. Personality measures of perseverence, competitiveness, achievement orientation, responsibility, and independence, as measured by self-reported personality instruments, were strongly correlated to medical school first year success (Markert, 1982).

Undergraduate grade point average and LSAT were evaluated as predictors of performance during three years of law school for a heterogeneous sample of 23 law schools

encompassing 3 years of graduates at each (Powers, 1982). The contribution of each predictor was uneven across the three years, with LSAT being stronger in the first year and undergraduate GPA stronger in the last year, but both measures being significant in all years. Explanation for the unevenness could lie in the qualities being assessed by the two measures.

> Although an admissions test like the LSAT may contribute more than undergraduate GPA to capturing the qualities needed to make a successful transition from undergraduate to legal education, the contribution of undergraduate GPA may increase in later years, relative to that of the LSAT, because it better captures qualities like persistence and motivation, which may be needed more in the second and third years. (Powers, 1982, p. 574)

No correlation was found between undergraduate GPA and a master's degree competency examination (MCE) in a program for students in an educational psychology program (Bean, 1975). In a similar study of a counselor education master's program Omizo and Michael (1979) found a correlation of .17 between undergraduate GPA and MCE. In both studies correlations of statistical significance at levels greater than .05 were found between Graduate Record Examination (GRE) scores and graduate grade point average.

Both the above studies were limited to one school and one program. Use of high undergraduate cut-off scores for entry into either program could have accounted for low and no correlation of undergraduate grades, since the lower the variability in range of correlates the lower the correlation will be, all else being equal (Zeleznik et al., 1983).

A somewhat different conclusion was reached as to the contribution of undergraduate grade point average to prediction of successful completion of engineering master's degree candidates by Malstrom, Klecka, and Shell (1984). Maintaining that the typical acceptance/rejection criteria for entry into engineering graduate programs of undergraduate GPA, name and reputation of institution granting the applicant's undergraduate degree, and Graduate Record Examination scores had not proven accurate in predicting successful completion of the degree, Malstrom et al. (1984) undertook an analysis to identify variables relating to success and failure.

The sample used for the above analysis was 89 applicants to the University of Cincinnati for master's degrees in industrial and mechanical engineering. All of the 89 either completed the degree or were dropped for academic reasons. Potential subjects not completing for reasons other than academic were not used in the study. Nine variables were identified and coded for the analysis. They were number of honors, scholarships, and awards received; undergraduate GPA; whether schooling was to be full- or part-time; age group (two groups, 0-24 and 25 and above, were used); children at home; indication of prestige of undergraduate institution; and two variables defining amount of work experience. Using discriminant analysis procedures (Klecka, 1980), Malstrom et al. (1984) completed six analyses: three using 3.0 on a 0-4.0 grade scale as

predictors of success or failure and three analyses to determine truly superior performance, using 3.5 on a 0-4.0 scale as the criteria. The first analysis in each of the two categories included all nine variables, the next analysis the six best predictors, and the third analysis used the five best predictors resulting from the success/failure studies. In the pass/fail prediction studies the derived equation using all nine variables and the equation using the best six predictors resulted in the same percentage of correct predictions for success and failure (77.9% and 91.7%, respectively). Dropping the additional variable lowered the percentages to 76.6 successes and 83.3 failures correctly predicted. The equations for predicting high scores produced correct predictions 67.6% of the time for attaining high scores and 73.1% of the time for failure to attain high scores when using all nine variables. When using the best six predictors, results of 67.6% and 75% were obtained for attainment and failure to attain high scores, respectively. The three variables with little or no predictive value in the success/failure study were number of children, age group, and prestige of the institution granting the undergraduate degree. For the predictions concerning high performance the three low contribution variables were number of children, age group, and the variable indicating a high degree of work experience (Malstrom et al., 1984).

Malstrom et al. (1984) found the five variables for both the criteria, listed in order of significance of contribution to the predictive equations, to be (a) number of honors, awards, and scholarships previously awarded, (b) whether full-time or part-time student, (c) possession of some work experience, (d) undergraduate GPA, and (e) marital status.

The low contribution of undergraduate GPA to the predictive equations was thought to be misleading.

> This does not imply that grades are not important. UGQPA (Undergraduate Quality Point Average) was found to be highly correlated with honors. This correlation resulted in the lower ranking of UGQPA, because this variable had only a small amount of unique discriminating information to add to the model. (Malstrom et al., 1984, p. 234)

The above study was of limited sample size and certainly not representative of all engineering schools or of all engineering disciplines. Whether it will prove to be representative awaits findings from subsequent studies (Malstrom et al., 1984). Exclusion of GRE scores as a variable in the study was due to unavailability of data, as was exclusion of information concerning prior award of graduate degrees (Malstrom et al., 1984).

The Relationship Between NROTC Program Parameters and Post-Graduation Training Performance

The U.S. Navy Training Analysis and Evaluation Group (TAEG) conducted a study "to establish and describe the relationship betweem the NROTC officer accession program and the performance of NROTC graduates in post-accession

(follow-on) training" (Heidt & Zajkowski, 1982, p. 9). A major product of the study was information and analyses "demonstrating the relationship between NROTC preparation and post-accession training" (Heidt & Zajkowski, 1982, p. 11), analyzed by post-accession training program and by variables related to the institution granting the undergraduate degree.

Entry and completion scores, as applicable to the individual post-accession training schools, were the primary dependent variables in the study. Other data elements used in the study are as follows:

1. College--The instituion, having an NROTC unit, from which the subject student graduated.

2. Major--The final academic field of study in which the student was enrolled as an undergraduate. Classification of major was made in accordance with Chief of Naval Education and Training Instruction 1533.12A (1975).

3. Institutional rank--Level of competitiveness as extracted from Barron's Profiles of American Colleges (1977), based on entry requirements and percentage of applicants accepted.

4. Type of institution--Whether a multipurpose university, an institution with primarily technical emphasis, or a Letters, Arts and Sciences (LAS) institution.

5. Environment--Classification as to whether the institution attended was urban, suburban, or rurally located.

6. Control--Classification as to school controlling agency. Classifications used were public, private, and Roman Catholic.

7. Coed status--Classification as to whether or not the institution attended was a male-only institution.

8. Size--Classification of the size of the attended institution into one of five categories based on undergraduate student enrollment.

9. Ethnic predominance--Classification as to whether or not the institution had a predominantly minority group student body.

10. Salary--Categorization of attended institutions based on the average salary of faculty.

The five post-accession training programs evaluated by Heidt and Zajkowski (1982) and their respective total NROTC graduates assigned during the study periods are as follows:

Flight Training (pilot only)--2174

Supply Corps School--490

Surface Warfare Officer (SWO) School--1758

Nuclear Power School--504

Submarine Officer Basic Course--269

The totals for each of the training groups indicate the maximum number in the study. Attrition and incomplete data sets necessitated that the numbers of subjects be different in many of the analyses.

One of the significant findings of Heidt and Zajkowski (1982) was that, "In almost every comparison, using GPA or

class standing criteria, persons with technical backgrounds performed better" (p. 101). Noticeable exceptions were results from Supply Corps School, where much of the content material was not of a technical nature, as the term "technical" was used in the study, and in results from Nuclear Power School where the homogeneity of the structure of the student body precluded significant analysis (Heidt & Zajkowski, 1982). This homogeneity was probably a result of the stringent selection process, and the small proportion of non-technical students accepted to the school. "Attrition data (and setback data where available) show significantly greater losses per class among nontechnically trained students" (Heidt & Zajkowski, 1982, p. 101). In the case of Surface Warfare Officer School the setback rate for non-technical majors as compared to technical majors was over two times as great (3.9% of N = 509 compared to 10.4% of N = 460) (Heidt & Zajkowski, 1982).

Heidt and Zajkowski summarized institutional data analysis as follows:

> Rank (based on Barron's competitive levels of entering students), Type (multiversity, technical emphasis, liberal arts emphasis) and Ethnic Predominance were most likely to evoke consistent differences in performance during post-accession training. In general, the higher the ranking of an institution, the better the performance of its graduates; technical institution graduates did better, liberal arts institution graduates did less well; graduates of institutions with predominantly minority student bodies demonstrated poorer performance than did their counterparts from predominantly white institutions. (1982, p. 101)

In Surface Warfare Officer (SWO) school, where a pretest was used in each of the 21 areas of the curriculum also tested by criterion based completion of training testing, and in Flight Training, where pre-training exemption tests were given in mathematics and physics, subjects with technical majors also faired significantly better on the pre-instruction tests than did their counterparts with non-technical majors (Heidt & Zajkowski, 1982).

Analyses dealing with institutional variables revealed that those institutions with minority predominance and those institutions which were in Barron's lowest classification yielded similar data. This was attributed to the fact that four of the five schools in the lowest Barron's category were also the four institutions with minority predominance (Heidt & Zajkowski, 1982). The study leads to the conclusion that institution attended and academic major pursued were important predictors of success in naval officer post-accession training.

Performance of University of Florida NROTC graduates, compared with the means of all subjects, is presented as Appendix B.

Sex and Race as Predictors of Performance

Much has been written concerning the cultural bias of testing, particularly as related to achievement and aptitude testing. In determining what interpretations can be placed

on such tests it is important to relate the usefulness of the test to the performance one desires to predict.

> Every psychological test measures a behavior sample. Insofar as culture affects behavior, its influence will be and should be related in the test. The same cultural differentials that impair an individual's test performance are likely to handicap him in schoolwork, job performance, or any other activity we are trying to predict. (Anastasi, 1968, p. 558)

It, then, is important to assess not only whether there are racial or sexual differences in test scores or other predictive measures, but also to assess whether the differences in test scores or other predictive measures are indicative of differences in performance as measured by the correlation between the criteria and the test (Cronback, 1970). According to Anastasi "Bias can only occur if regression equations differ between groups as to intercept and/or slope" (1968, p. 559).

Goldman and Hewitt (1976) reviewed previous studies of the validity of college performance (GPA) predictions which used standardized tests. Their conclusion was that no evidence of systematic underprediction of GPA by use of standardized tests for Blacks existed, and that the SAT was about as predictively valid for Black students as for White students (Goldman & Hewitt, 1976).

In conducting their own study, Goldman and Hewitt (1976) collected data on self-reported ethnic group (Black, Oriental, Chicano, and White), college GPA, high school GPA, SAT-V score, and SAT-M score for students of four California institutions of higher learning. Using a regression

analysis for each institution, the contribution of each factor to college GPA was determined. Results obtained indicated that "ethnic group vectors add virtually nothing to the R^2 obtained using academic predictors alone" (Goldman & Hewitt, 1976, p. 114). It was further concluded that "There is little evidence of any appreciable ethnic differences in regression systems. In general slopes and intercepts do not differ significantly among ethnic groups. Controlling for major field did not alter the above findings" (Goldman & Hewitt, 1976, p. 115). High school GPA and SAT scores were found to be better predictors for White and Oriental students due to the higher inter-correlation between the two measures for Blacks and Chicanos (Goldman & Hewitt, 1976).

The Goldman and Hewitt study (1976) also showed evidence that college GPA is better predicted by the verbal sub-test of the SAT (SAT-V) than by the mathematical sub-test (SAT-M) for science and non-science related subjects. This finding was not supported by the findings of a study by Zak, Benbow, and Stanley (1983).

In the study by Zak, Benbow, and Stanley (1983), 63 chemistry majors were compared on 10 variables. The best predictors for college GPA from a one-way analysis of variance (ANOVA) procedure were, in order of variance explained, the chemistry achievement test of the CEEB series ($r = .46$), SAT-M ($r = .43$), and SAT-V ($r = .24$). From a stepwise regression procedure the best predictive equation

obtained for overall college GPA was GPA = .42 SAT-M + .13 SAT-V + .10 sex (m = 0, f = 1) - .08 age (Zak et al., 1983). This equation accounted for 23% of the variance in college GPA for the subjects. The SAT-M and the chemistry achievement test, as expected from the "r" values obtained from the ANOVA procedures, had the same predictive effect and could have been interchanged. The only statistically significant difference in variables, when compared by sex, was in SAT-V scores, females scoring slightly higher (Zak et al., 1983).

Similar conclusions to those of Goldman and Hewitt (1976) were drawn by Sanford (1977), as pertained to race. The purpose of Sanford's study was to relate several background variables to two conditions of post-baccalaureate activity: continuing education and current level of employment. A 25% sample which was random, except that it included all Black graduates, was queried with 257 responses of a possible 342 subjects. Variables, in addition to employment status and whether or not pursuing a higher degree, were (a) sex, (b) race, (c) level of mother's education, (d) level of father's education, (e) parents' income, (f) hometown size, (g) SAT scores, (h) major field, and (i) GPA at graduation (Sanford, 1977). The first theory tested by Sanford, using path analysis methods, was as follows.

> Bachelor level graduates who are white male and come from families with higher incomes, whose parents have more education, who have higher SAT

> scores and higher GPA's and who major in physical science or mathematics will be more likely to continue their education than other graduates at the bachelor level. (Sanford, 1977, p. 8)

Testing of the theory revealed that GPA, sex, and race had the greatest effect on outcome; that father's education level, SAT scores, major, and family income had slight impact; and that the other variables had no impact. In contra-indication of the theory, the contribution by race indicated that Blacks were somewhat more likely to continue education than Whites. The model derived using this analysis accounted for 27.8% of the total variance in outcome (Sanford, 1977). A low path coefficient between GPA and highest degree attained indicated that the brightest students might not be those who pursue the highest degrees (Sanford, 1977).

A similar analysis for income level of the subject graduates indicated a slightly smaller income for females than for males when all other variables were controlled. Race had no effect on outcome. The total variance in income explained by all variables was 3.7% (Sanford, 1977).

When analyzing for variables with significant impact on final GPA, Sanford (1977) found that all variables were significant to some degree, and that taken together the variables accounted for 23.5% of the variance. The variable found to have the most significance was SAT score, "which can be interpreted loosely to mean that a person's ability is a strong determinate of the grades a person earns in college" (Sanford, 1977, p. 14).

In Sanford's 1977 study race and GPA, when all other factors were considered, had a path coefficient of .02 which "indicates little if any notion of racial difference directly affecting a graduate's competence to achieve in college" (Sanford, 1977, p. 14). Wilson concluded much the same in stating "the correlational validity of minority and non-minority studies is similar when analyzing first year college GPA with SAT scores" (Wilson, 1981, p. 351). Wilson (1981) further concluded that first year GPA predictive criteria and long-term predictive criteria were compatible.

As previously mentioned the Sanford (1977) study was of a supposed random sample of subjects but included all Black graduates. It was limited to graduates only in a single year (1974) of a single institution.

Using much of the same data, Sanford (1982) sought to explore the possibility of predicting graduation from the University of North Carolina. Sex, race, residency (in-state or out-of-state), major, high school size, SAT scores, and predicted GPA (using high school rank and SAT scores) were chosen as variables for multiple regression analysis and discriminant analysis. Results of the regression analysis indicated that high school rank, predicted GPA, SAT-M, sex, and SAT-V were, in order of contribution, the predictors for white students and that high school rank, SAT-V, sex, predicted GPA, and SAT-M were the predictors, in order, for black applicants. Prediction equations employing these variables resulted in 56.65% correct predictions for

white subjects and 64.78% correct predictions for Black students. Analysis was conducted 5 years after enrollment. Discriminant analysis conducted at the sixth year after enrollment point did not yield greatly different results. Sanford (1982), in addressing the low predictability of the variables, concluded that (a) the variables selected may not be the ones that really make a difference in graduation attainment, (b) that pre-selection (i.e., to those admitted to college) limits the variability of several factors, and (c) that the variables important for graduation may not be the same for all students and may vary widely from student to student (Sanford, 1982).

Ecklund and Wisenbacker (1979), reporting on a survey of subjects enrolled in the national longitudinal study of high school seniors, indicated that more respondents of minority status reported special advantages accruing from race than discrimination due to race (Ecklund & Wisenbacker, 1979). Women were found more likely to graduate from college on schedule than men. Ratios of male to female students or former students in the physical science/mathematics disciplines and engineering disciplines were 3.5 to 1 and 4.3 to 1, respectively.

Many of the studies previously cited involved use of SAT scores as predictor variables. Considerable controversy concerning the usefulness and meaning of SAT scores has taken place, particularly since the publication of the Nairn report in 1980. In the cited studies and the study

conducted, SAT scores stand as data elements included in analysis rather than as "givers" of valid prediction as is claimed by some of the protagonists involved in the controversy (Trusheim & Crouse, 1982). Thus the elements of controversy are not considered significant to this review or to the study.

Relationship of Faculty Evaluation of Leadership Potential to Measures of Leadership

The validity of teacher ratings of leadership ability to observed measures of leadership was addressed in a study by Priest and Adams (1980). Citing the dearth of empirical evidence previously reported, Priest and Adams (1980) performed correlational analysis of 10 teacher rated attributes thought to measure student leadership potential as rated by the subjects' high school faculty, with measures of leadership as observed and rated by cadet officers, army officers, and upperclass cadets at the U.S. Military Academy, West Point, New York. Also included in the analysis were student self-ratings. The attributes on which the evaluations were made were of a non-cognitive nature, and included items such as observations of participation in athletic activities, extra-curricular activities, and other group situations. Size of the sample population was 15,557. Priest and Adams (1980) found significant positive correlation between the ratings by high school teachers and the observations by those at the academy. No correlation

was found between student self-ratings and those of the other two groups.

Summary of the Review of Literature

Though grade point average and class standing in higher education are the most frequently used predictors of subsequent success, the literature reviewed was not supportive of that use. Measures of aptitude, such as the Scholastic Aptitude Test (SAT) and the Armed Services Vocational Aptitude Battery (ASVAB), were reported to be indicators of future success in academic and training endeavors, though the evidence was mixed and far from conclusive. Evidence of a relationship between the aptitude measures, SAT and ASVAB, and success in endeavors other than academic ones was even less conclusive.

Race and sex were found to be of little or no significance in relationship to test scores and grade point averages.

Evidence was presented that students graduated from institutions with technical emphasis, and students who completed technical majors performed better, on average, in naval officer post-acquisition training than those from liberal arts institutions and those with non-technical majors.

Leadership ratings of students, by high school teachers, were found in one study to be positively related to subsequently demonstrated leadership.

CHAPTER III

METHODOLOGY

Collection and Coding of Data

The source of data utilized in this study was U.S. Navy records. The records consulted included midshipman personal performance records, academic transcripts, and reports generated by the Naval Reserve Officer Training Corps Automated Data System (NROTCADS). Permission to use these sources was obtained and is included as Appendix C. The data collected, the coding used in the analysis, and the values assigned to the variables are listed in Table 1.

It is to be assumed that the variables listed in Table 1 may be considered to be in the following categories: (a) categorical variables--SX, RC, PG1, PG2, YR, TN, GNG; (b) independent variables--STOT, VRB, MTH, AP, UGPA, NGPA; (c) dependent variables--S2, S3, SS. Independent variables are further considered to be either entry variables--those variables used as selection criteria, and performance variables--those variables indicative of performance while attending the university and Participating in the NROTC program. Considered as entry variables are STOT, VRB, and MTH. Variables UGPA, NGPA, and AP are considered to be performance variables.

Table 1. Variables and coding.

Variable	Code	Codible values	Definition of value
Sex	SX	0	Male
		1	Female
Race	RC	0	Caucasian
		1	Negro
		2	American Indian
		3	Asian
Program	PG1	4	National competition
		5	College program
		6	CNET scholarship
	PG2	1	Four-year student
		2	Three year student
		3	Two year student
		4	One year student
SAT(total)	STOT	0-1600	Reported score
SAT(verbal)	VRB	0-800	Reported score
SAT(math.)	MTH	0-800	Reported score
Year taken	YR	80-83	
Technical/ non-tech.	TN	0	Technical major
		1	Non-technical major
Graduation status	GNG	0	Grad., commissioned
		1	Grad., not comm.
		2	Non-graduate
Aptitude	AP	1	First quartile
		2	Second quartile
		3	Third quartile
		4	Fourth quartile
University GPA	UGPA	0.00-4.00	Cumulative GPA
Naval Sci. GPA	NGPA	0.00-4.00	Composite score
NCE(full)	SS	0-100	Obtained score
NCE(sect. 2)	S2	0-100	Obtained score
NCE(sect. 3)	S3	0-100	Obtained score

One hundred and thirty-three data sets were obtained, representing information concerning the 133 examinees completing the Navy Comprehensive Examination (NCE) at the University of Florida during academic years 1980-1981 through 1983-1984. As previously noted, not all data sets contained information concerning all variables. Information was not available concerning the variables VRB and MTH in 41 instances, and information was not available concerning STOT in 39 instances.

Upon completion of initial data collection, a sequence number was assigned to each data set, and all personal identification purged from the data. No personally identifiable information was needed for the study. The purged information was entered into and retained in a computerized data bank and duplicated on punch cards and printed copy. Release 82.4 of the Statistical Analysis System (SAS) was used for all computations reported in this document.

Analysis Procedures

A correlation matrix using all data elements was determined as the first analysis procedure. Sorts on categorical variables of interest and correlation matrices for the sorts were then determined. Sorts on variables indicated as likely to be of interest in previous literature and studies included race, sex, and technical majors. Sorts and subsequent analyses were completed for categorical

variables sex (SX), race (RC), technical/non-technical major (TN), and program code (PG1, PG2). Regression analysis using a stepwise procedure was employed to determine predictive equations in those cases where the probability of correlation indicated likely significant results. Indications of the amount of variation in obtained scores explained by the predictor variables, determined by the regression procedure to be significant, were calculated as a part of the procedure. Scores from parts 2 and 3 of the Navy Comprehensive Examination were included in the correlational studies for the purpose of discovering any differential effect of independent variables on the part scores. Throughout this study significance level was defined by being at or greater than a probability value of .95.

Results of Pilot Study

A pilot study utilizing an abbreviated data base was accomplished as a proof of concept. Statistical analyses as indicated above were accomplished and results reviewed and critiqued by Steven Olejnik, Ph.D., formerly of the University of Florida. No significant problems were indicated.

The variables SS, UGPA, NGPA, AP, STOT, and TN were included in the pilot study. Correlations at significant levels were indicated between each independent variable and the dependent variable (SS) in the undifferentiated model.

In the differentiated models (sorted by TN) AP did not correlate in either model. Regression equations for the differentiated model relative to non-technical majors and the undifferentiated model showed STOT and UGPA to be significant predictor variables. For the model relative to technical majors STOT and NGPA were found to be the predictor variables. Amount of variation accounted for by the predictor variables was .251, .317, and .192 for the all subjects model, non-technical majors model, and technical majors model, respectively.

CHAPTER IV

ANALYSIS AND PRESENTATION OF DATA

Presented in this chapter are the summary, correlational, and regression analyses of data concerning all examinees who completed the Navy Comprehensive Examination administered at the University of Florida in academic years 1980-1981 through 1983-1984. Analyses were conducted using the entire population of the study and sub-populations sorted by the categorical variables identified previously. The chapter consists of two parts, the first containing results of the summary and correlational analyses, and the second comprising the results of the regression analyses. The first section is subdivided with respect to the categorical variable by which the population was divided.

Tables 2 through 19 present descriptive information and results of the correlation of variables and are individually referred to in subsequent sections of this chapter. Variables used in Table 2 and subsequent tables and in the regression equations in this chapter are identified by the code listed in column two of Table 1, page 40.

Summary and Correlational Analyses

Undifferentiated Data Set

One hundred and thirty-three subjects comprised the study population and full data sets were available for 92 of the subjects. Data concerning performance variables (UGPA, NGPA, AP) and dependent variables (S2, S3, SS) were available for the entire population. Mean values for variables included scores of 1083.7 for the Scholastic Aptitude Test (STOT), 2.67 for the cumulative university grade point average (UGPA), 3.39 for the Naval Science Department grade point average, and a mean aptitude score of 2.44. Means of scores on the Navy Comprehensive Examination (NCE) were 50.47, 50.08, and 49.54 with standard errors of the means calculated to be 0.95, 0.85, and 0.91 for part 2 (S2), part 3 (S3), and the entire test (SS), respectively. NCE scores (S2, S3, SS) are standardized scores having a mean of 50 and a standard deviation of 10, using the nationwide population of examinees as the base group. The mean scores of the study population did not statistically differ from the national examinee population.

Table 2 contains summary data regarding each of the independent and dependent variables for the undifferentiated study population. Data included in Table 2 and subsequent summary tables are number of data sets applicable, maximum value of the variable, minimum value of the variable, mean of variable scores, and the standard deviation of the data

Table 2. Summary data; entire population.

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	92	320	650	510.7	84.5
MTH	92	350	780	577.2	93.8
STOT	98	740	1370	1083.7	150.45
Performance Variables					
UGPA	133	1.66	3.91	2.67	0.45
NGPA	133	2.00	4.00	3.39	0.43
AP	133	1	4	2.44	1.14
Dependent Variables					
S2	133	18	75	50.47	11.00
S3	133	21	75	50.07	9.76
SS	133	22	76	49.54	10.51

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

distribution for each of the independent and dependent variables.

A matrix of correlation coefficients determined for every combination of dependent and independent variables is presented in Table 3. Information in each of the data blocks of Table 3 and all subsequent tables containing correlation information includes, from top to bottom, correlation coefficient, probability value, and number of data pairs used to calculate the correlation coefficient. For the purpose of this study, and as used in subsequent discussion, probability values at or less than .05, indicating that the correlation coefficient is significant at a .95 or greater level of probability (Ary, Jacobs, & Razavieh, 1979), are considered to be statistically significant.

Statistically significant correlations were found between each of the dependent variables (S2, S3, SS) and all other variables except AP. Correlation of university grade point average (UGPA) with the dependent variables S2, S3, and SS produced coefficients of .2559, .2361, and .3152, respectively. Correlation of Naval Science Department grade point average (NGPA) with the dependent variables produced coefficients of .3131, .3785, and .3980 with S2, S3, and SS, respectively. There was no significant correlation between the aptitude variable (AP) and any of the entry variables (VRB, MTH, STOT) or the part 2 score of the NCE (S2). The variable AP correlated with UGPA and NGPA with coefficients

Table 3. Correlation of variables; entire data set.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.4833 .0001 92	.8460 .0001 92	.2341 .0247 92	.3067 .0029 92	.0644 .5418 92	.4110 .0001 92	.4021 .0001 92	.4496 .0001 92
MTH			.8753 .0001 92	.1885 .0719 92	.3755 .0002 92	-.0080 .9390 92	.2806 .0068 92	.3752 .0002 92	.3596 .0004 92
STOT				.2318 .0216 98	.3582 .0003 98	.0306 .7647 98	.3868 .0001 98	.4487 .0001 98	.4552 .0001 98
UGPA					.4666 .0001 133	-.4157 .0001 133	.2559 .0030 133	.2561 .0029 133	.3152 .0002 133
NGPA						-.2040 .0185 133	.3131 .0002 133	.3785 .0001 133	.3980 .0001 133
AP							-.1198 .1694 133	-.1818 .0363 133	-.2115 .0145 133
S2								.5725 .0001 133	.8118 .0001 133
S3									.7084 .0001 133
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

of .-4157 and -.2024, respectively. Coefficients of correlation for variable AP with the dependent variables were -.1818 and -.2115 for S3 and SS, respectively. The reader is reminded that for the aptitude variable higher performance is represented by the lower numerical score, whereas for other variables higher performance is indicated by higher scores. Thus a negative correlation coefficient obtained with AP as one of the covariables is indicative of a positive relationship between the attributes described by the variables.

Data Differentiated by Sex

Data sets were sorted by sex of the subject and separate analyses conducted using the resultant differentiated data sets. The means of scores on each variable were lower for the data set representative of the female population of the study than for that of the male population. However, t-tests for statistical significance in the difference of the means, calculated for each of the dependent variables, indicated that only the difference in the means for variable S2 was statistically significant at a confidence level at or greater than 0.95.

Table 4 presents summary data sorted by sex. Within each data segment of the table the first number indicates the value obtained from the data set for male subjects and the second number indicates the value obtained from the data set for female subjects.

Table 4. Summary data; sorted by sex (data = male/female).

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	84/8	320/380	650/610	515.36/462.50	83.87/80.67
MTH	84/8	390/350	780/680	583.21/513.90	89.85/116.98
STOT	89/9	760/740	1370/1280	109.28/968.89	143.60/117.02
Performance Variables					
UGPA	117/16	1.66/2.07	3.91/3.66	2.66/2.74	.45/.51
NGPA	117/16	2.00/2.88	4.00/4.00	3.39/3.43	.43/.42
AP	117/16	1/1	4/4	2.45/2.37	1.14/1.15
Dependent Variables					
S2	117/16	18/23	75/63	51.32/44.25	10.43/13.30
S3	117/16	21/31	75/62	50.62/46.13	9.57/10.55
SS	117/16	23/22	76/62	49.96/46.50	10.21/12.44

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Correlation coefficients were determined for all combinations of the entry, performance, and dependent variables for each of the data sets differentiated by sex. Table 5 presents the correlation matrix for data from female subjects only data set, and Table 6 presents correlations of variables from the male only data set.

Considering data from the female subject data set, statistically significant correlations were obtained for 11 of the 36 combinations of variables. This low number of correlations is in part accounted for by the low number of data sets available (n = 8, 9, or 16) (Ary, Jacobs, & Razavieh, 1979). From the female only data set the only independent variable which was correlated with the dependent variables was NGPA, with coefficients of .5322, .6710, and .7156 obtained with dependent variables S2, S3, and SS, respectively. Correlations of variables NGPA and UGPA (coefficient = .5450) and variables UGPA and AP (coefficient = -.6601) were of statistical significance.

For variables from the male subject data set, all possible pairs of variables resulted in statistically significant correlations except combinations of the variable AP with any of the entry variables or the S2 variable, and variable MTH with UGPA. When paired with the dependent variables (S2, S3, SS), the entry variables (VRB, MTH, STOT) resulted in higher correlation coefficients than did the pairings of dependent variables with performance variables (UGPA, NGPA, AP). The correlations between NGPA and the

Table 5. Correlation of variables; female subjects only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.7982 .0176 8	.9269 .0009 8	.2119 .6145 8	.4973 .2099 8	.3765 .3572 8	-.3770 .3572 8	.2708 .5166 8	.1779 .6734 8
MTH			.9659 .0001 8	.4595 .2520 8	.5101 .1965 8	.0810 .8488 8	-.2505 .5495 8	.1186 .7797 8	.2372 .5717 8
STOT				.3875 .3028 9	.3688 .3287 9	.1839 .6357 9	.2424 .5298 9	.2025 .6012 9	.2528 .5117 9
UGPA					.5435 .0296 16	-.6601 .0054 16	.2571 .3364 16	.4318 .0948 16	.4887 .0547 16
NGPA						-.3658 .1636 16	.5322 .0338 16	.6710 .0040 16	.7156 .0018 16
AP							-.1507 .5774 16	-.0262 .9234 16	-.2008 .4559 16
S2								.7039 .0023 16	.8493 .0001 16
S3									.8629 .0001 16
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 6. Correlation of variables; male subjects only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.4303 .0001 84	.8350 .0001 84	.2517 .0209 84	.3042 .0049 84	.0412 .7098 84	.4851 .0001 84	.4094 .0001 84	.4740 .0001 84
MTH			.8557 .0001 84	.1764 .1084 84	.3829 .0003 84	-.0165 .8819 84	.3446 .0013 84	.0414 .0002 84	.3810 .0004 84
STOT				.2347 .0268 89	.3858 .0002 89	.0242 .8223 89	.4568 .0001 89	.4740 .0001 89	.4791 .0001 89
UGPA					.4555 .0001 117	-.3793 .0001 117	.2764 .0026 117	.2405 .0090 117	.2934 .0013 117
NGPA						-.1829 .0485 117	.2950 .0012 117	.3481 .0001 117	.3569 .0001 117
AP							-.1241 .1826 117	-.2105 .0227 117	-.2181 .0122 117
S2								.5344 .0001 117	.8046 .0001 117
S3									.6772 .0001 117
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

dependent variables were stronger than those between UGPA and the dependent variables.

Data Differentiated by Race

A sorting of data by the categorical variable race was performed. Only one subject each for racial category 2 (American Indian) and racial category 3 (Asian) were included in the study population. Data were summarized for racial categories 0 (Caucasian) and 1 (Negro). Means of each variable were lower for the category 1 data set than for the category 0 data set except for the variable AP. The T-tests of the differences in means, calculated for differences in means of each of the dependent variables, resulted in a determination of significance for means of variables S2 and SS. Summary data for race codes 0 and 1 are presented in Table 7. Within each data segment the first number represents data from race category 0 and the second number represents data from race category 1.

Tables 8 and 9 present correlations of all variables of race category 0 and 1, respectively. As expected from the small data base available (n = 4), few correlations were available from the race category 1 data. The correlation of university grade point average (UGPA) and Navy Comprehensive Examination score (SS) resulted in a correlation coefficient of .9693.

For race group 0 (Caucasian), there was found to be correlation between each of the dependent variables and each

Table 7. Summary data; sorted by race (data = Caucasian/Negro).

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	88/4	320/350	650/370	516.36/360.00	81.44/10.00
MTH	88/4	350/410	780/440	582.84/430.00	91.56/17.32
STOT	93/4	740/760	1370/910	1096.02/820.00	143.05/63.77
Performance Variables					
UGPA	127/4	1.66/1.98	3.91/2.56	2.68/2.33	.46/.25
NGPA	127/4	2.00/2.13	4.00/3.94	3.41/3.15	.41/.87
AP	127/4	1/1	4/4	2.41/3.00	1.14/.82
Dependent Variables					
S2	127/4	18/20	75/45	51.02/35.50	10.76/11.15
S3	127/4	21/35	75/50	50.34/42.75	9.83/6.60
SS	127/4	22/23	76/40	50.09/35.00	10.31/8.04

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 8. Correlation of variables; Caucasian subjects only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.4265 .0001 88	.8251 .0001 88	.1993 .0627 88	.2683 .0115 88	.1180 .2736 88	.3567 .0006 88	.3710 .0004 88	.3908 .0002 88
MTH			.8625 .0001 88	.1563 .1459 88	.3516 .0008 88	.0350 .7459 88	.2203 .0392 88	.3457 .0010 88	.3008 .0044 88
STOT				.1942 .0620 93	.3483 .0006 93	.0957 .3613 93	.3123 .0023 93	.4200 .0001 93	.3865 .0001 93
UGPA					.4727 .0001 127	-.4122 .0001 127	.2283 .0098 127	.2368 .0073 127	.2860 .0011 127
NGPA						-.1961 .0272 127	.3256 .0002 127	.3620 .0001 127	.3892 .0001 127
AP							-.0814 .3627 127	-.1638 .0658 127	-.1853 .0370 127
S2								.5637 .0001 127	.8017 .0001 127
S3									.7011 .0001 127
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 9. Correlation of variables; Negro subjects only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.8660 .3333 3	.9449 .2123 3	-.0822 .9476 3	.9891 .0940 3	-.5000 .6667 3	-.1099 .9299 3	.6547 .5456 3	.0558 .9645 3
MTH			.9820 .1210 3	-.5695 .6143 3	.7831 .4273 3	0.0000 1.0000 3	-.5921 .5966 3	.1890 .8790 3	-.4509 .7022 3
STOT				.4578 .5422 4	.8081 .1919 4	-.0640 .9360 4	-.1735 .8266 4	.4276 .5724 4	.3055 .6945 4
UGPA					.4059 .5941 4	-.6560 .3440 4	.7794 .2206 4	.7251 .2749 4	.9693 .0309 4
NGPA						-.4953 .5047 4	.0117 .9883 4	.3971 .6029 4	.3971 .6029 4
AP							-.8055 .1945 4	-.9276 .0724 4	-.8123 .1877 4
S2								.6317 .3683 4	.8848 .1152 4
S3									.8163 .1838 4
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

of the independent variables with the following exception: there was no correlation between the aptitude variable and the dependent variables S2 and S3. There was no relationship found between AP and any of the entry variables. There was no relationship of statistical significance between university grade point average (UGPA) and any of the entry variables (VRB, MTH, STOT), whereas the correlations between Naval Science Department grade point average and entry variables were statistically significant. For dependent variables S2 and SS the highest correlation was with entry variable VRB, the score on the verbal portion of the Scholastic Aptitude Test, with correlation coefficients of .3567 and .3908, respectively. Coefficients of correlation between S2 and NGPA and between SS and NGPA were determined to be .3256 and .3892, respectively.

Data Differentiated by Technical Nature of Major

Data sets were sorted with respect to the academic major of the subject. The academic major in which a degree was granted or the major at the time of departure from the university was used.

The 133 subjects were enrolled in 27 different majors. A determination was made as to the technical nature of major and data coded for each subject. Data were sorted into sub-populations of technical or non-technical majors. The categorization of majors and determination of technical or non-technical nature of the major were made in accordance

with Chief of Naval Education publication 1533/7 (1980). The data set for technical major contained data from 74 subjects; that of the non-technical majors contained data from 59 subjects.

In the comparison of summary data for the two data sets, the mean values of scores on each of the variables were higher for the technical major data set than for the non-technical data set, with the exception of the aptitude variables, AP. This exception is not unexpected considering the manner in scoring the AP variable. Tests for significance of the difference in the means were performed, resulting in a determination of statistically significant difference for each of the difference of means of the dependent variable.

Summary data for the data differentiated by the technical nature of the subjects' academic major are presented in Table 10. Within each data block of Table 10 the first number appearing is applicable to the technical major data set. The second number in each block is applicable to the non-technical major data set.

Statistically significant relationships were explored among every combination of variables in each of the data sets. Matrices of correlation coefficients for all combinations of independent and dependent variables are presented as Tables 11 (technical major) and Table 12 (non-technical majors).

Table 10. Summary data; sorted by technical nature of academic major (data = technical major/non-technical major).

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	48/44	320/350	640/650	517.29/503.64	80.68/88.87
MTH	48/44	390/350	780/730	615.21/535.68	78.33/88.87
STOT	52/46	810/740	1370/1360	1123.46/1038.70	134.48/156.21
Performance Variables					
UGPA	74/59	1.68/1.66	3.91/3.49	2.77/2.56	.45/.43
NGPA	74/59	2.67/2.00	4.00/3.94	3.58/3.16	.32/.44
AP	74/59	1/1	4/4	2.20/2.75	1.05/1.16
Dependent Variables					
S2	74/59	23/18	75/68	52.68/47.71	9.53/12.13
S3	74/59	32/21	75/69	52.08/47.56	9.37/9.73
SS	74/59	29/22	76/67	51.92/46.56	9.62/10.90

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 11. Correlation of variables; technical majors only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.4514 .0013 48	.8580 .0001 48	.2139 .1444 48	.3052 .0349 48	.0014 .9927 48	.4369 .0019 48	.4346 .0020 48	.4186 .0031 48
MTH			.8447 .0001 48	.1185 .4224 48	.1283 .3847 48	.2118 .1484 48	.3765 .0084 48	.2392 .1016 48	.1929 .1820 48
STOT				.2041 .1467 52	.2076 .1398 52	.0773 .5860 52	.4722 .0004 52	.4146 .0022 52	.3684 .0072 52
UGPA					.5015 .0001 74	-.3342 .0036 74	.1934 .0987 74	.3109 .0070 74	.2330 .0457 74
NGPA						-.2032 .0824 74	.2435 .0365 74	.4506 .0001 74	.3950 .0005 74
AP							-.0192 .8711 74	-.2734 .0184 74	-.1449 .2181 74
S2								.4900 .0001 74	.7735 .0001 74
S3									.6618 .0001 74
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 12. Correlation of variables; non-technical majors only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.5370 .0002 44	.8714 .0001 44	.2305 .1323 44	.3198 .0343 44	.1686 .2739 44	.3817 .0106 44	.3604 .0163 44	.4678 .0014 44
MTH			.8818 .0001 44	.0710 .6468 44	.2484 .1039 44	.0567 .7148 44	.1173 .4481 44	.3561 .0182 44	.3965 .0077 44
STOT				.1583 .2933 46	.2933 .0479 46	.1362 .3669 46	.2767 .0627 46	.4054 .0052 46	.4816 .0007 46
UGPA					.3504 .0065 59	-.4400 .0005 59	.2415 .0654 59	.0929 .4842 59	.3200 .0135 59
NGPA						.0224 .8662 59	.2360 .0719 59	.1896 .1500 59	.2709 .0380 59
AP							-.1160 .3818 59	.0188 .8877 59	-.1768 .1804 59
S2								.6109 .0001 59	.8271 .0001 59
S3									.7722 .0001 59
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

From the data set applicable to technical majors, the highest correlation of variables with Navy Comprehensive Examination score (SS) was with the variable VRB, the score on the verbal portion of the Scholastic Aptitude Test. The variable NGPA, the variable indicative of Naval Science Department grade point average, was the variable next most highly related to the variable, SS. For the technical major data, variable AP was related only to UGPA and S3 variables. Variables AP and MTH were not related to dependent variable, SS.

With the exception of the correlation between VRB and NGPA, the entry variables, VRB, MTH, and STOT, did not relate significantly to any of the performance variables. The variable NGPA was more closely related to the dependent variables than was the variable UGPA.

In contrast to the data from the technical majors data set, for the non-technical major data, variable MTH, representing the grades on the mathematical portion of the Scholastic Aptitude Test, was significantly related to variables S3 and SS, with correlation coefficients of .3561 and .3965, respectively. The variable VRB was significantly related to all dependent variables, with coefficients of .3817, .3604, and .4678 for correlations with S2, S3, and SS, respectively. Unlike the data from the technical majors data set, UGPA was more strongly related to Navy Comprehension Examination score than was NGPA, with correlation coefficients of .3200 and .2709, respectively.

In the non-technical data set variable AP was related only to UGPA. As with the technical major data, university grade point average (UGPA) was not significantly related to any of the entry variables.

Data Differentiated by Scholarship Status of the Subjects

In data sorts by program code, the first sort conducted was as to whether or not subjects were recipients of U.S. Navy scholarships. The scholarship status at the time of taking the Navy Comprehensive Examination (NCE) established the scholarship status. Of the 133 subjects, 99 were recipients of U.S. Navy scholarships.

The means of values for each variable were greater for scholarship recipients than for non-recipients. Tests for statistical significance for the difference of mean values were indicative of significance for each of the dependent variables. Summary data for scholarship recipients and non-recipients are presented in Table 13. For each of the data segments of Table 13 the first number applies to the scholarship recipient data set; the second applies to the non-recipient data set.

Correlation computations were performed for all combinations of the independent and dependent variables, as sorted by scholarship status. For the scholarship recipient data set, scores on the verbal portion of the SAT, variable VRB, was found to be the independent variable most strongly

Table 13. Summary data; sorted by scholarship status (data = scholarship data/non-scholarship data).

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	67/25	320/350	650/610	523.28/477.20	80.52/87.39
MTH	67/25	390/350	780/730	612.54/482.40	74.33/73.05
STOT	72/26	810/740	1370/1310	1128.61/959.23	133.50/123.67
Performance Variables					
UGPA	99/34	1.66/1.78	3.91/3.49	2.71/2.56	.46/.42
NGPA	99/34	2.20/2.00	4.00/3.90	3.50/3.11	.36/.50
AP	99/34	1/1	4/4	2.42/2.50	1.26/1.19
Dependent Variables					
S2	99/34	18/20	75/65	51.61/47.18	10.20/12.63
S3	99/34	32/21	75/71	51.36/46.32	8.98/11.04
SS	99/34	25/22	72/76	50.92/45.53	9.49/12.33

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

related to dependent variables S1 and SS, with coefficients of correlation of .4190 and .4059, respectively. The performance variable UGPA, indicative of university grade point average, was not related to the dependent variables nor was UGPA related to any of the entry variables, consisting of part scores and total score on the Scholastic Aptitude Test. No relationship was found to exist between Naval Science Department grade point average (NGPA) and any of the entry variables. A relationship was evident between NGPA and each of the dependent variables, having coefficients of correlation of .2058, .3205, and .2755 with variables S2, S3, and SS, respectively. The aptitude variable, AP, was related to both UGPA and NGPA. A relationship, with a correlation coefficient of -.2030, was evident between the aptitude variable and the Navy Comprehensive Examination score. A matrix of all correlations from the scholarship recipient data set is presented in Table 14.

Unlike the scholarship data set, for the data set applicable to non-scholarship students university grade point average (UGPA) was most strongly related to the dependent variables S2 and SS, with correlation coefficients for the relationship of .5757 and .6319, respectively. The UGPA was also found to be related to dependent variable S3, a coefficient of .3826 describing the relationship. The variable most closely related to dependent variable S3 was found to be the entry variable STOT, represent total score on the Scholastic Aptitude Test, with a coefficient of

Table 14. Correlation of variables; scholarship students only.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.5166 .0001 67	.8829 .0001 67	.1896 .1244 67	.1142 .3575 67	.0500 .6873 67	.4190 .0004 67	.3388 .0050 67	.0459 .0007 67
MTH			.8575 .0001 67	.1005 .4184 67	.0780 .5302 67	.1436 .2463 67	.2864 .0188 67	.2849 .0195 67	.2469 .0440 67
STOT				.1649 .1662 72	.0726 .5444 72	.0905 .4499 72	.3959 .0006 72	.3703 .0014 72	.3709 .0013 72
UGPA					.5000 .0001 99	-.4317 .0001 99	.1119 .2703 99	.1781 .0778 99	.1647 .1034 99
NGPA						-.2903 .0036 99	.2058 .0410 99	.3205 .0012 99	.2755 .0058 99
AP							-.1168 .2497 99	-.1839 .0684 99	-.2030 .0439 99
S2								.4723 .0001 99	.7665 .0001 99
S3									.6070 .0001 99
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

correlation between the two of .5121. The scores from the math portion of the Scholastic Aptitude Test (MTH) were not found to be related to any of the dependent variables. Performance variable NGPA was related to dependent variables S2 and SS, with coefficients of correlation of .3800 and .4614, respectively. The aptitude variable was found to be related only to variable NGPA. Table 15 presents a matrix of correlation coefficients for variables contained in the data set for subjects not on U.S. Navy scholarships.

Data Differentiated by Number of Years as a Member of NROTC

The final differentiation of data by categorical variable consisted of sorting by categorical variable PG2, indicating the number of years subjects were enrolled in the NROTC program. Those subjects enrolled for four years completed Naval Science Department courses in sequence. Those subjects enrolled for three years were enrolled in first year and second year naval science courses simultaneously. Those subjects enrolled for two years, and in the case of two subjects-one year, took the first and second year naval science courses in concentrated form at the Naval Science Institute, Newport, Rhode Island. These courses were taken in the summer session between the sophomore and junior years of college.

Summary data for four, three, and two year students are presented in Table 16. Information regarding the subjects

Table 15. Correlation of variables; subjects not on scholarships.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.2315 .2655 25	.8264 .0001 25	.3091 .1327 25	.4089 .0424 25	.1440 .4923 25	.3406 .0957 25	.4291 .0323 25	.4579 .0213 25
MTH			.7391 .0001 25	.4001 .0475 25	.2457 .2366 25	-.2608 .2081 25	.1361 .5164 25	.3743 .0653 25	.4258 .0338 25
STOT				.4339 .0268 26	.4136 .0357 26	-.0465 .8214 26	.3100 .1233 26	.5121 .0031 26	.5573 .0031 26
UGPA					.3607 .0361 34	-.3713 .0306 34	.5757 .0004 34	.3826 .0255 34	.6319 .0001 34
NGPA						-.0511 .7739 34	.3800 .0267 34	.3290 .0575 34	.4614 .0060 34
AP							-.1172 .5092 34	-.1722 .3300 34	-.2297 .1912 34
S2								.7180 .0001 34	.8768 .0001 34
S3									.8531 .0001 34
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 16. Summary data; sorted by number of years as an NROTC student (data = 4 year/3 year/2 year students).

Variables[a]	Number	Minimum	Maximum	Mean	Standard Deviation
Entry Variables					
VRB	53/11/26	360/360/320	650/540/610	535.85/469.09/476.54	82.43/60.24/84.14
MTH	53/11/26	390/440/350	780/690/670	606.23/593.64/513.08	83.76/89.92/88.17
STOT	55/12/29	790/800/740	1370/1210/1280	1135.09/1065.83/994.48	144.17/136.88/130.92
Performance Variables					
UGPA	74/15/42	1.81/1.66/2.07	3.91/3.13/3.49	2.74/2.44/2.67	.47/.43/.38
NGPA	74/15/42	2.00/2.75/2.13	4.00/3.83/4.00	3.49/3.38/3.26	.41/.37/.45
AP	74/15/42	1/1/1	4/4/4	2.41/2.67/2.36	1.13/.97/1.19
Dependent Variables					
S2	74/15/42	24/20/18	75/60/65	54.04/45.47/46.21	9.76/10.29/11.28
S3	74/15/42	33/35/21	72/64/75	52.61/48.33/46.43	9.52/7.63/9.84
SS	74/15/42	30/23/22	76/66/65	53.14/47.93/44.48	9.06/9.65/10.81

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

enrolled for only one year is not included in any of the data sets sorted by years enrolled. In each data segment of Table 16, the first number represents data from the four year data set, the second number data from the three year data set, and the third number data from the two year data set.

Means of scores for all variables were higher for four year students than for three or two year students, except for aptitude score. Differences in means were tested for statistical significance at the .95 confidence level, for all dependent variables. For each of the variables the tests indicated no significant difference in the means between the three year and two year groups. The differences in the means between the four year and three year groups, and between the four year and two year groups, were significant at the .95 confidence level except for the difference between means for variable S3 between the four year and three year groups.

Correlation coefficients were determined for all the combinations of variables for each of the groups from the by year sorting. Tables 17, 18, and 19 present the correlation coefficients in matrix form.

The comments included in this paragraph apply to data from the four year student data set. Entry variable MTH and performance variables UGPA and AP were not related to any dependent variable at a significant level. The relationship of the entry variable VRB with the dependent variables S2,

Table 17. Correlation of variables; 4 year students.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.4762 .0003 53	.8585 .0001 53	.1036 .4602 53	.4115 .0022 53	.1389 .3211 53	.3272 .0168 53	.3150 .0216 53	.3915 .0037 53
MTH			.8591 .0001 53	.1393 .3197 53	.3136 .0222 53	.0098 .9448 53	.1930 .1661 53	.2633 .0568 53	.2271 .1019 53
STOT				.1461 .2872 55	.3648 .0062 55	.0579 .6744 55	.3183 .0179 55	.3620 .0066 55	.3793 .0043 55
UGPA					.4041 .0004 74	-.4257 .0002 74	.1410 .2310 74	.1376 .2425 74	.1859 .1127 74
NGPA						-.0202 .8644 74	.2735 .0184 74	.2666 .0217 74	.2988 .0097 74
AP							.0406 .7313 74	-.1095 .3530 74	-.0027 .9815 74
S2								.5181 .0001 74	.7533 .0001 74
S3									.6896 .0001 74
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 18. Correlation of variables; 3 year students.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.8093 .0025 11	.9294 .0001 11	.3874 .2391 11	.2479 .4624 11	-.8326 .0015 11	.5847 .0589 11	.3383 .3089 11	.6373 .0349 11
MTH			.9689 .0001 11	.0134 .9687 11	.1658 .6261 11	-.5600 .0732 11	.5418 .0851 11	.6113 .0457 11	.5426 .0846 11
STOT				.1864 .5620 12	.2220 .4881 12	-.6542 .0210 12	.5559 .0606 12	.4559 .1364 12	.5522 .0627 12
UGPA					.7447 .0014 15	-.4486 .0935 15	.4000 .1385 15	.0624 .8252 15	.4828 .0683 15
NGPA						-.4046 .1347 15	.5999 .0181 15	.3281 .2326 15	.6104 .0157 15
AP							-.4669 .0793 15	.3005 .2764 15	-.6394 .0349 15
S2								.5843 .0222 15	.7945 .0004 15
S3									.7982 .0004 15
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

Table 19. Correlation of variables; 2 year students.

Variable[a]	VRB	MTH	STOT	UGPA	NGPA	AP	S2	S3	SS
VRB		.2441 .2294 26	.7773 .0001 26	.3335 .0962 26	-.0041 .9984 26	.1456 .4780 26	.2375 .2427 26	.3135 .1189 26	.2635 .1934 26
MTH			.7998 .0001 26	.3741 .0598 26	.4820 .0126 26	.0718 .7275 26	.0954 .6430 26	.2709 .1806 26	.1767 .3880 26
STOT				.4286 .0203 29	.2536 .1844 29	.1363 .4809 29	.2212 .2488 29	.3500 .0627 29	.2779 .1443 29
UGPA					.4996 .0008 42	-.3101 .0456 42	.2726 .0807 42	.4721 .0016 42	.3756 .0142 42
NGPA						-.4372 .0038 42	.1319 .4050 42	.4229 .0053 42	.3153 .0419 42
AP							-.2519 .1075 42	-.2853 .0671 42	-.3902 .0106 42
S2								.5168 .0005 42	.8596 .0001 42
S3									.6468 .0001 42
SS									

[a]VRB = SAT Verbal; MTH = SAT Math; STOT = SAT Total; UGPA = University GPA; NGPA = Naval Science Department GPA; AP = Aptitude Score; S2 = Navy Comprehensive Examination Section 2; S3 = Navy Comprehensive Examination Section 3; SS = Navy Comprehensive Examination Total Score.

S3, and SS was strongest of that of any of the independent variables, having correlation coefficients of .3772, .3150, and .3915 with variables S2, S3, and SS, respectively. A relationship was found between NGPA and each of the entry variables. The variable AP was related only to UGPA, the two having a correlation coefficient of .4257.

From the data set pertaining to students in the NROTC program for three years only, the relationships between the Navy Comprehensive Examination score (SS) and the variables VRB, NGPA, and AP resulted in coefficients of .6373, .6104, and -.6394, respectively. No other variables were related, at statistically significant levels, with the dependent variable SS. Dependent variable S3 was found to be related only to variable MTH, and dependent variable S2 was found to be related only to NGPA.

For data pertaining to two year NROTC students, dependent variable SS was found to be related to all performance variables and no entry variables. Coefficients of correlation between the Navy Comprehensive Examination score (SS) and performance variables UGPA, NGPA, and AP were .3756, .3153, and -.3902, respectively. The dependent variable S2 was found to be unrelated to any of the independent variables, and variable S3 was found to relate to performance variables UGPA and NGPA only, with coefficients of correlation of .4721 and .4229. As is the case for data groupings, the reader is encouraged to consult the appropriate tables for more detailed information.

Results of Regression Analyses

Linear regression analysis was employed in order to determine predictive equations for scores on the Navy Comprehensive Examination, dependent variable (SS), and for assessing the amount of variance in the dependent variable accounted for by the independent variables. A stepwise procedure was used for addition to and continued inclusion in the equation. Significance level for entry (SLE) and significance level for remaining (SLR) were set at .10. Equations were formed for the same data sorts as used in the summary and correlational analyses of the previous section of this chapter, with the exception of data sorted by race and by sex. For data sets applicable to female subjects and data sets applicable to Negro subjects, only a single independent variable was related to the dependent variable SS; thus any equation to describe the relationship would only include that term. Equations describing those relationships are included below. Correlations between variable SS and each of the independent variables for the male data set and for the Caucasian data set, compared with the same correlations for the total data set, indicate that regression equations from the male only and Caucasian only data sets would not differ significantly from the equation for the total data set. Equations describing the relationship for male subjects only and Caucasian subjects only are not included.

The model used for the regression determination was as follows:

SS = AP NGPA UGPA VRB MTH STOT

The results of the regression analysis for the entire population and each of the sub-populations are presented below.

1. Population = entire study population
$\hat{SS} = 3.691 + 5.757(NGPA) + 0.025(STOT)$
$R^2 = 0.267$

2. Population = female subjects only
$\hat{SS} = 2.293 + 0.024(NGPA)$
$R^2 = 0.512$

3. Population = racial category 1 only
$\hat{SS} = 1.911 + 0.014(UGPA)$
$R^2 = 0.744$

4. Population = technical majors only
$\hat{SS} = -4.699 + 8.481(NGPA) + 0.0235(VRB)$
$R^2 = 0.192$

5. Population = non-technical majors only
$\hat{SS} = 0.882 + 6.803(UGPA) + 0.029(STOT)$
$R^2 = 0.317$

6. Population = scholarship students only
$\hat{SS} = 27.981 + 0.0453(VRB)$
$R^2 = 0.165$

7. Population = students not on scholarships
$\hat{SS} = -20.603 + 11.753(UGPA) + 0.039(STOT)$
$R^2 = 0.456$

8. Population = four year students
$\hat{SS} = 31.048 + 0.043(VRB)$
$R^2 = 0.153$

9. Population = three year students
$\hat{SS} = -0.612 + 0.099(VRB)$
$R^2 = 0.406$

10. Population = two year students
No variables met the significance level requirements for entry into the model.

In order to assess the contribution of each of the variables, independent of the affect of other variables, to the variance in Navy Comprehensive Examination scores, a linear regression on Navy Comprehensive Examination score was performed for each of the variables--category of major, Scholastic Aptitude Test (SAT) score, university grade point average (UGPA), Naval Science Department grade point average (NGPA), and aptitude quartile score (AP). Goodness of fit was determined for each of the resulting regressions. For each of the variables, the percentage of variance in the Navy Comprehensive Examination scores accounted for by the independent variable, when the effect of no other variable is considered, is shown below:

Independent variable	percent of variance explained
Category of major	6.46
SAT score	20.72
NGPA	15.84
UGPA	9.10
AP	4.47

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The intent of this study was to explore the relationships among several independent variables indicative of university and Naval Reserve Officers Training Corps (NROTC) entrance criteria and performance measures and the results obtained on the Navy Comprehensive Examination, across several categories of students, for the purpose of determining which, if any, of the independent variables relate significantly to Navy Comprehensive Examination scores. For the purpose of this study the Navy Comprehensive Examination has been considered as a competency examination and a pre-professional entrance examination, indicating students' readiness for entry into post-accession training and for entry into the naval profession. Throughout this study the assumption has been made that the Navy Comprehensive Examination is valid for those purposes.

Problems addressed in the study were the requirement for an 80%/20% ratio of technical majors to non-technical majors, and the appropriateness of the use of the Scholastic

Aptitude Test (SAT), particularly the score on the mathematics section of the Scholastic Aptitude Test, as a criterion for the award of Navy scholarships, and the usefulness of university grade point average and Naval Science Department grade point average as indicators of performance while in the Naval Reserve Officers Training Corps.

Specifically, the following null hypotheses were tested to accomplish the intent of the study.

1. There are no relationships between the categorical variables of sex, race, major, and program and scores on the Navy Comprehensive Examination.

2. There are no relationships between the entry variables of SAT scores and scores on the Navy Comprehensive Examination.

3. There are no relationships between the performance variables, university grade point average, Naval Science Department grade point average, and aptitude quartile score and scores on the Navy Comprehensive Examination.

4. There are no relationships among the categorical, entry, and performance variables.

5. The categorical, entry, and performance variables provide no predictive indication of Navy Comprehensive Examination scores.

A review of literature relative to the subject indicated that the grade point average obtained in institutions of higher education has seldom been found to be

a reliable predictor of success in subsequent professions, but that grade point average or class standing was frequently an indicator of success in subsequent activities similar to attendance at institutions of higher education, such as academically oriented professional preparation.

The literature concerning the use of the Scholastic Aptitude Test (SAT) as an indicator of academic success was inconclusive. Little evidence of the use of the SAT or other measures of aptitude as predictors of professional success was reported.

Race and sex were not found to be critical variables relative to the purposes of this study in any of the literature reviewed.

Heidt and Zajkowski (1982) reported that students graduating from institutions with predominantly technical emphasis and students who completed academic majors of a technical nature, on average, achieved higher scores in U.S. Navy post-accession training than did their counterparts from liberal arts institutions and those students who completed academic majors in fields not considered to be of a technical nature.

The study population was comprised of students who completed the Navy Comprehensive Examination in academic years 1980-1981 through 1983-1984. The entire population, consisting of students at the University of Florida (N = 133), was used for the study. Of that population, 117 members were male. Racial composition of the population was

Caucasian, 127; Negro, 4; American Indian, 1; Asian, 1. Seventy-four of the subjects had technical academic majors. Of the population of 133, 99 subjects were recipients of U.S. Navy scholarships. Seventy-four of the subjects participated in the NROTC for four years, 15 participated for three years, and 42 participated for two years. Two students participated for only one year.

Methodology used in the analysis consisted of completing the steps which follow.

1. Data were collected concerning each subject. Data collected consisted of the categorical variables sex, race, number of years in the NROTC program, scholarship status, and academic major; independent variables Scholastic Aptitude Test scores, including part scores, university grade point average, Naval Science Department grade point average, and aptitude quartile score; and the dependent variables Navy Comprehensive Examination scores, including the scores on parts 2 and 3, the sections most heavily emphasizing the physics, mathematical, and engineering related competencies. Majors were then classified as to the technical nature of the subject matter as defined by the Navy.

2. Summary data and a correlation matrix of all independent and dependent variables were computed.

3. Subjects were sorted by the categorical variables. Summary data and correlation matrices were computed for each of the sub-sets of subjects.

4. Linear equations were determined for the dependent variable, Navy Comprehensive Examination score, for the entire population and each of the sub-sets of population. A stepwise regression method was used to form the equations. A linear regression was completed for the Navy Comprehensive Examination score using each of the independent variables alone.

Findings

The major findings emerging from the analysis of data are reported below, in relation to the hypotheses tested.

Hypothesis One

The hypothesis that there existed no relationship between the categorical variables and scores on the Navy Comprehensive Examination was not supported. As pertains to the relationships between the variable sex and the dependent variables, only for the Navy Comprehensive Examination part 2 score was there a significant difference between male and female subjects. As pertains to race, no findings were available concerning racial categories 2 and 3, since only one subject was available in each category. Any conclusions drawn concerning differences in Navy Comprehensive Examination scores between racial category 0 (Caucasian) and racial category 1 (Negro) are highly suspect due to the low number of subjects comprising category 1 (N = 4).

Comparison of the means of the dependent variable indicated that racial category 0 students, on the average, performed significantly better than racial category 1 students on part 2 of the Navy Comprehensive Examination and on the Navy Comprehensive Examination as a whole. Means of scores on both parts of the Navy Comprehensive Examination and the Navy Comprehensive Examination total score were significantly higher for technical majors than for non-technical majors. Differences in means of the scores were, for part 2, part 3, and entire Navy Comprehensive Examination, 4.97, 4.52, and 5.36, respectively. The reader is reminded that Navy Comprehensive Examination scores, both the part scores and the total score, are standardized scores, with a mean of 50 and a standard deviation of 10.

The means of scores on the dependent variables were significantly higher for scholarship students than for students who were not attending the university on a navy scholarship. Differences in the means for part 2, part 3, and Navy Comprehensive Examination total score were 4.43, 5.04, and 5.39, respectively.

The means of grades on the Navy Comprehensive Examination and the Navy Comprehensive Examination part 2 were significantly higher for four year students than for three or two year students. No appreciable difference was found between the mean scores of the three year students and the mean scores of two year students.

Hypothesis 2

The hypothesis that no relationship existed between the Scholastic Aptitude Test (SAT) scores and scores on the Navy Comprehensive Examination was not supported by the analyses, as applied to the entire data set. A correlation coefficient of .4552 was found to describe the relationship between the SAT score and the Navy Comprehensive Examination score. The verbal section of the SAT was found to be related to the Navy Comprehensive Examination score by a correlation coefficient of .4446, and the mathematics section of the SAT was related to the Navy Comprehensive Examination, the two having a coefficient of correlation of .3596. Each of the part scores of the Navy Comprehensive Examination was also found to be related to the SAT scores and to each component score of the SAT. It is of interest to note that the scores on the verbal section of the SAT were more closely related to the Navy Comprehensive Examination score than were the scores on the mathematics section of the SAT.

In the case of data sets differentiated by sex, the hypothesis was supported as applied to the female subjects data sub-set. This finding of no correlation is suspect due to the low number of data pairs available for the comparison (N = 8). The relationships between the Navy Comprehensive Examination scores and Scholastic Aptitude Test (SAT) scores for the male population were similar to those of the total population, as would be expected. For data differentiated

by race, no relationships between the SAT scores and the Navy Comprehensive Examination scores were found for the data sub-set consisting of Negro subjects. As in the case of the female data set, the low number of data pairs on which to calculate the correlations (N = 3 or N = 4) made the discovery of a meaningful relationship unlikely. The relationship between the SAT scores and the Navy Comprehensive Examination scores for the Caucasian sub-set of population was similar to that of the entire population.

When the data set was differentiated by the technical nature of the academic major of the subjects, it was found that, for the technical majors sub-set, there was a relationship between SAT score and Navy Comprehensive Examination score, with a correlation coefficient of .3684 for the relationship. However, the scores on the mathematics section of the SAT did not relate significantly to the Navy Comprehensive Examination total scores or to the Navy Comprehensive Examination part 3 scores. For the technical majors sub-set of data, scores on the verbal section of the SAT were found to be related to scores on both parts of the Navy Comprehensive Examination and to the overall Navy Comprehensive Examination scores, coefficients of .4369, .4346, and .4186 describing the relationship of the verbal section of the SAT to part 2, part 3, and the complete examination, respectively. For the non-technical data set the SAT was related to the Navy Comprehensive Examination as shown in Table 12. For each of the parts of

the Navy Comprehensive Examination and for the Navy Comprehensive Examination as a whole the verbal section of the SAT was more closely related to the Navy Comprehensive Examination scores than was the mathematics section of the test.

When the data were sorted by scholarship status of the students, it was found that the Scholastic Aptitude Test (SAT) and each of the parts of the test were related to the Navy Comprehensive Examination and each of its parts, for the scholarship recipient group. For this group the verbal section of the SAT was more closely related to the Navy Comprehensive Examination scores than was the mathematics section or the SAT composite score. For the sub-set not receiving scholarship benefits, none of the SAT scores were related to the Navy Comprehensive Examination part 2 score. For part 3 and total Navy Comprehensive Examination score, the SAT verbal score was more closely associated with the dependent variable than was the SAT mathematics score.

In differentiations of data by number of years in the Naval Reserve Officers Training Corps (NROTC) program, the hypothesis was supported by the analyses for two and three year students. For four year students the SAT verbal score was more closely associated with the dependent variables than was either the SAT mathematics score or the combined SAT score.

Hypothesis 3

The hypothesis that there is no relationship existing between Navy Comprehensive Examination scores and the performance variables university grade point average, Naval Science Department grade point average, and aptitude quartile score was not supported as applied to the entire population. Though correlation coefficients between independent variables and Navy Comprehensive Examination scores were lower for performance variables than for the entry variables, the relationships were of statistical significance. Correlation coefficients of .3152, .3980, and -.2115 were determined for the relationship between the Navy Comprehensive Examination and university grade point average, Naval Science Department grade point average, and aptitude quartile score, respectively. The negative correlation coefficient in the case of aptitude quartile score with other variables indicates a positive relationship between the variables, since an aptitude score of 1 indicates placement in the highest quartile and a score of 4 indicates placement in the lowest quartile.

Of the possible relationships of dependent variables with performance variables, only the relationship between aptitude quartile score and Navy Comprehensive Examination part two score was found not to be significant. For the female data set, only Naval Science Department grade point average was found to be related to the Navy Comprehensive Examination or either of the part scores. A relatively high

correlation coefficient of .7156 indicated the closeness of the relationship between Naval Science Department grade point average and Navy Comprehensive Examination score. As applied to the male population the hypothesis was supported for the relationships of performance variables with the Navy Comprehensive Examination part 2 score, but false for relationships with part 3 and total Navy Comprehensive Examination scores.

When sorted by racial category, the findings applicable to the entire population apply to the Caucasian sub-group. For the Negro sub-set, only university grade point average was found to be related to Navy Comprehensive Examination score. The correlation coefficient for the relationship was determined to be .9693.

For the technical majors sub-set, Naval Science Department grade point average was more closely related to the dependent variables than any other performance variable, and aptitude quartile score was found to be related only to the Navy Comprehensive Examination part 3 scores. For the non-technical majors, aptitude quartile score was not related to any of the dependent variables and university grade point average was more closely related to Navy Comprehensive Examination scores than was Naval Science Department grade point average.

For scholarship recipients Naval Science Department grade point average was more closely related to the dependent variables than was either of the other performance

variables. University grade point average was not significantly related to Navy Comprehensive Examination scores, either the part scores or the total score. Aptitude quartile score was found to be related, for the scholarship recipient sub-set, only to the total Navy Comprehensive Examination score. For the non-recipient sub-group university grade point average was more closely related to Navy Comprehensive Examination scores than was Naval Science Department grade point average, and the aptitude quartile score was not found to be related to any of the dependent variables.

When the data were sorted by number of years of participation in the NROTC program, the hypothesis was found true as applied to university grade point average and aptitude quartile score for four year students and as applied to university grade point average for three year students. For four year students Naval Science Department grade point average was found to relate to the Navy Comprehensive Examination score and both Navy Comprehensive Examination part scores, with coefficients of .2735, .2666, and .2988 for part 2, part 3, and total test, respectively. For three year students Navy Comprehensive Examination scores were found to be more closely related to Naval Science Department grade point average with coefficients of .5999, .3281, and .6104, for the part 2, part 3, and total Navy Comprehensive Examination scores. For two year students the closest relationship between performance

variables and Navy Comprehensive Examination was between aptitude quartile score and Navy Comprehensive Examination, with a coefficient of correlation of .3902.

Hypothesis 4

The hypothesis that there is no relationship among the categorical, entry, and performance variables was not supported. The indications of the multitude of relationships among the variables can be found in the tables contained in the previous chapter. Several of the more striking relationships, or absence of relationships, are noted as follows.

There was no relationship found between the Scholastic Aptitude Test mathematics section scores and university grade point average for the total data set or for any of the sub-sets of the population except for the non-technical majors sub-set. Aptitude scores were, in general, more closely related to university grade point average than to any other dependent variable. Naval Science Department grade point average was related to each of the entry variables when considering the entire data set. Neither university grade point average nor Naval Science Department grade point average was related to entry variables for the population sub-set consisting of scholarship students.

Hypothesis 5

The hypothesis that no predictive indications are provided by the categorical, entry, and performance variables was not supported. The regression procedures previously described resulted in a prediction equation for Navy Comprehensive Examination scores which accounts for 26.7% of the variance in Navy Comprehensive Examination scores. The equation produced is as follows: SS = 3.691 + 5.757 NGPA + 0.025 STOT, where SS is the predicted Navy Comprehensive Examination score, NGPA is the grade point average for Naval Science Department courses, and STOT is the total score for the Scholastic Aptitude Test.

The hypothesis was supported only as applied to the data set comprised of two year NROTC students. The predictive equations for various population sub-sets are provided in the previous chapter. It is of interest to note that, of the entry variables, the verbal section of the Scholastic Aptitude Test was included in four of the equations and the complete SAT score was included in three equations. One would not expect to find both the verbal score and the total score, or the mathematics and the total score in the same equation, since the verbal and mathematics scores comprise the total score, and the relationship between the part scores and total score is strong.

The contribution of the performance variables was found to be uneven across the various population sub-sets, with Naval Science Department grade point average being a

significant predictor in three equations (entire population, female subjects, and technical majors), and university grade point average being of significance in three equations (Negro subjects, non-technical majors, and subjects not receiving scholarships).

In summary, all the null hypotheses were tested and found to be unsupported as applied to the entire study population. Testing of the hypotheses for sub-sets of the population, differentiated by the categorical variables, revealed that the relationships of the independent variables to the dependent variables were not uniform across sub-sets as to degree of the relationship or as to the variables significantly related to the dependent variables. Additionally, the relationships among independent variables was not uniform across sub-sets.

A finding not directly related to the purposes of this study was that concerning the relationship of scores on the mathematics section of the Scholastic Aptitude Test and university grade point average. In only one population sub-set, that of those subjects not attending school on Navy scholarships, was there found to be any statistically significant relationship between the two variables. For the study population in its entirety, the mathematics section of the Scholastic Aptitude test was not significantly related to university grade point average. The verbal section of the Scholastic Aptitude test was significantly related to university grade point average.

Conclusions

The conclusions which comprise this section of the study pertain to the problems addressed in Chapter I, namely the advisability of the goal of an 80%/20% ratio of technical to non-technical majors in the Naval Reserve Officers Training Corps (NROTC) program, and the value of the use of the current entry and performance measuring criteria. Throughout this section the assumption is made that the Navy Comprehensive Examination is a valid indication of future performance in post-accession training and in subsequent careers. Testing of this assumption is anticipated (Heidt, Zajkowski, & Hodak, 1979).

The comments strictly apply only to the subjects involved in the study. To the extent that the study subjects are statistically similar to subsequent NROTC populations at the University of Florida, and to populations at other NROTC host institutions, these conclusions apply. The means of scores for the Navy Comprehensive Examination (total and part) for the study population are statistically similar to the means of the national population. In addition the frequency distributions accompanying the report of Navy Comprehensive Examination grades for the study population closely resemble the national distribution. These two factors lend credence to generalizations of findings and conclusions to the broader population.

Insofar as the concern with the ratio of technical to non-technical majors is concerned, the data support the

assumption that students completing technical majors are better prepared for post-accession training and careers in the Naval Service as indicated by higher Navy Comprehensive Examination scores, than those with non-technical majors. This conclusion is in consonance with the findings of Heidt and Zajkowski (1982). However, the amount of variance accounted for by major classification alone, exclusive of other variables, is small (6.46%). To the extent that the findings are generalizable and the Navy Comprehensive Examination is accurate for predictive purposes, the amount of variance in Navy Comprehensive Examination scores accounted for by category of major is probably not sufficient to justify curtailment of the NROTC program at institutions not able to meet the 80%/20% requirements.

Causal factors accounting for the difference in Navy Comprehensive Examination results are not readily apparent, though the data indicate that, on the average, technical majors exceed non-technical majors in every category. The possibility exists that students likely to be more successful in academic type pursuits are more likely to choose technical majors. The assumption made in determining the policy requiring the ratio may also be true; that is, that in a profession requiring technical expertise, those entering the naval profession with technical education are better prepared than those not so educated. Another alternative cause, and in the opinion of the author, based on experience in the field of post-accession training, the

most likely cause is that of the similarity of educational practices between the technical disciplines and those of post-accession training. The education and training practices employed in post-accession training and the educational practices employed in the technical disciplines are very similar, and thus the student educated in a technical discipline has been accustomed to the practices, such as presentation of material and testing methods, while the student who had pursued a non-technical degree may not be so accustomed to those methods. This increased familiarity with methodology may account for the contribution of category of major, exclusive of factors such as aptitude, prior achievement, or motivation. The conclusions of Zeleznik, Hojat, and Veloski (1983) concerning similarities in testing methods for medical school students address the same subject.

Results of the study indicate that concern with the use of the Scholastic Aptitude Test as an entry criterion for the NROTC program is not well founded. Scholastic Aptitude Test scores were found to be significantly related to Navy Comprehensive Examination scores for the study population. The emphasis placed on the mathematics section of the Scholastic Aptitude Test as a selection criterion is not justified by the findings of this study. The findings do not appear to be contaminated by any restrictions in range of the mathematics section of the Scholastic Aptitude Test caused by use of that variable as a selection criterion for

the study population. Examination of the range of scores for the verbal and mathematics sections of the Scholastic Aptitude Test indicates similar range of scores for the two variables.

Results of the study indicate that, for the study population considered in its entirety, the performance measures of university grade point average, Naval Science Department grade point average, and aptitude quartile are indicative of future performance as measured by the Navy Comprehensive Examination. Concern that these measures are not indicative of future performance are, therefore, not well founded. That Naval Science Department grade point average was found to be more closely related to Navy Comprehensive Examination than the other performance measures was not unexpected, since the Navy Comprehensive Examination and the Naval Science Department courses are both drawn from the same source, The Minimum Professional Core Competencies for Officer Accession Programs Manual. The lower correlation coefficient for the aptitude quartile score with the Navy Comprehensive Examination was unexpected. That measure accounted for only 4.47% of the variance in Navy Comprehensive Examination scores when considered exclusive of any of the other variables.

The following conclusion is not related to the problems addressed by this study, as indicated in Chapter I, but is germaine to the controversy surrounding the use of the Scholastic Aptitude Test. The low coefficients of

correlation found between university grade point average and Scholastic Aptitude Test scores, both part scores and total score, and the absence of any relationship between those measures for various sub-groups of the population indicate that the Scholastic Aptitude Test is not a particularly good indicator of academic performance. The low values of the coefficients indicate that other factors influence academic performance more than those factors measured by the Scholastic Aptitude Test. That the Scholastic Aptitude Test, either part score or total score, and university grade point average were not related to a statistically significant degree for the sub-population of technical majors was of particular interest. The differing correlation coefficients obtained between the Scholastic Aptitude Test and university grade point average for the different sub-groups of the population of the study indicate that factors affecting academic performance as measured by university grade point average are unequal across the groups, and the factors may be different for the various groups.

The absence of a relationship between the mathematics section of the Scholastic Aptitude Test and university grade point average for technical majors indicates that the qualities measured by the mathematics section of the Scholastic Aptitude Test are not the same as the qualities needed for academic performance in a technical major. Data from this study indicate that where the Scholastic Aptitude

Test is to be used as an indication of academic aptitude, to be translated to academic performance as indicated by grades, the verbal section of the test is a more accurate indicator than the mathematics section of the test for almost all categories of students studied.

Recommendations

The recommendations which follow are drawn from the findings and conclusions of this study. Recommendations one and two deal with establishing the validity of the assumptions made concerning the Navy Comprehensive Examination and the generalizability of the results. Recommendations one through three are directed primarily to the Naval Reserve Officers Training Corps (NROTC) program, while recommendations four and five are applicable to the NROTC program and higher education in general.

1. It is recommended that studies establishing the validity of the Navy Comprehensive Examination as a predictor of performance in post-accession training be completed, and that studies be undertaken relating Navy Comprehensive Examination performance, post-accession training performance, training performance, and professional performance. Without knowledge of such relationships the usefulness of the Navy Comprehensive Examination and measures pertaining to it are of limited, conjectural value as a measure of professional preparation. The sources utilized by Heidt and Zajkowski (1982) and the NROTC

Automated Data System could provide the bulk of the data necessary for such a study.

2. Studies of a nature similar to this study should be undertaken using data from each of the NROTC host institutions and data from a composite of all institutions. Such a study would provide indication of the constancy of the relationships of variables across institutions, indications of differences in contributing variables by type and location of institution, and indications of the generalizability of findings.

3. The relatively weak relationship between the aptitude quartile score and the Navy Comprehensive Examination scores, as well as the weak relationship of the aptitude quartile score and university grade point average and Naval Science Department grade point average, indicates that the evaluations of aptitude used to derive the aptitude quartile score may be of little use. It is recommended that a substantial review of the evaluation procedures be conducted. This review should encompass both the underlying theory, the regulatory framework, and the practices employed in the evaluative process, with an objective of determining a system that yields results more closely related to the qualities for which measurement is desired.

4. In an effort to further identify the variables significantly impacting on performance, both as university students and as future Naval Officers, for different students, it is recommended that exploratory studies be

undertaken, differentiating the population in a number of ways. As an example, data such as that used in this study might be utilized, sorting it by score intervals of the independent and dependent variables.

5. Conclusions of this study regarding the relative importance of the mathematics section of the Scholastic Aptitude Test as a predictor of Navy Comprehensive Examination scores and university grade point average, particularly those results for the technical majors sub-population, leads to the recommendation that emphasis on the use of that score as a selection criterion be diminished and that more emphasis be placed on the verbal section of the examination. This recommendation applies to both the use as a selection criterion for Navy scholarships and as a criterion for entry into institutions of higher education and into technical majors. It is further recommended that additional studies, with an expanded population representative to the population of the institution, be undertaken to confirm the generalizability of the findings concerning the mathematics section scores.

APPENDIX A

INSTITUTIONS PARTICIPATING IN THE TRAINING ANALYSIS AND EVALUATION STUDY OF A REVISED CURRICULUM FOR THE NAVAL RESERVE OFFICERS TRAINING CORPS

Pilot Program Institutions	Control Institutions
University of Minnesota	University of Wisconsin
University of Rochester	Renssalaer Polytechnic
Southern University	Prairie View A&M College
Miami University of Ohio	University of Kansas
University of Idaho	University of Utah
University of North Carolina	University of Florida
Duke University	Vanderbilt University
Villanova University	Marquette University

The pilot institutions represent both public and privately funded institutions, large and small student populations, different institutional types, and various geographic sectors. Control counterparts are similar to the pilot program institutions in those aspects.

APPENDIX B

SYNOPSIS OF UNIVERSITY OF FLORIDA GRADUATES' PERFORMANCE IN POST-ACCESSION TRAINING

Surface Warfare Officer School

	Pretest	Criterion test	Setback %
U.F.	1.52(.81)/28	3.49(.25)/26	7.1
All NROTC	1.57(.83)/1071	3.50(.50)/883	7.6

Supply Corps School

	Composite score
U.F.	87.56(6.02)/6
All NROTC	88.63(4.54)/371

Submarine Officer Basic School

	Final average
U.F.	78.96(3.4)/7
All NROTC	82.32(3.65)/211

Nuclear Power School

	Final average
U.F.	3.19(.22)/15
All NROTC	3.22(.25)/504

Aviation Training (Pilot)

	Flight indoctrination	Primary flight
U.F.	52.2(6.82)/22	50.9(4.52)/13
All NROTC	53.3(6.97)/840	52.74(6.54)/532

format = average score (standard deviation)/number of subjects

APPENDIX C

PERMISSION TO USE NAVY DATA

DEPARTMENT OF NAVAL SCIENCE

UNIVERSITY OF FLORIDA
Gainesville, Florida 32611

25 March 1985

From: G.B. Riefler, Chairman, Naval Science Department
To: Dr. James Hensel, Chairman, Doctoral Committee for Sidney E. Wheeler

Subj: DOCTORAL DISSERTATION UTILIZING DEPARTMENT OF THE NAVY INFORMATION

1. CDR Wheeler has discussed using data from this department in preparation of his dissertation. This is to inform you that use of this data is approved. It is desired that a copy of the dissertation be provided this department. The proposed study is of interest to this department and to higher headquarters. Dr. W. Malloy, Principal Advisor to the Chief of Naval Education and Training and a member of the Florida Board of Regents has expressed interest in the study.

2. The facilities and records of this department have been made available to CDR Wheeler for use in the proposed study and the staff instructed to assist when necessary. In addition, computer time for data analysis has been made available.

[signed]
G.B. Riefler
CAPT USN

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BIOGRAPHICAL SKETCH

Sidney Earl Wheeler is a native of Macon, Georgia. He attended Griffin High School, Griffin, Georgia, and received the Bachelor of Science degree from The United States Naval Academy, Annapolis, Maryland, in 1962. Mr. Wheeler received the Master of Science degree in personnel administration from the George Washington University in 1969, the Master of Science degree in oceanography from the Naval Postgraduate School, Monterey, California, in 1974, and pursued graduate studies in psychology at Pacific Lutheran University from 1979 through 1980. Mr. Wheeler has served on the faculties of the United States Naval Academy, City College, Seattle, and most recently at the University of Florida where he was Associate Professor of Naval Science. Mr. Wheeler is a Commander in the United States Navy (Ret.) and a Naval Aviator, having served in ships and aviation squadrons in all parts of the world. Mr. Wheeler is a combat veteran of the Vietnam War and the recipient of several military decorations. He is married and has two sons.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James W. Hensel, Chairman
Professor of Educational Leadership

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert G. Dean
Graduate Research Professor of
Coastal and Oceanographic
Engineering

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Gordon D. Lawrence
Professor of Educational Leadership

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1985

Dean, College of Education

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